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EU-Indonesia Trade Cooperation Facility

MINISTRY OF ENERGY AND MINERAL RESOURCES
REPUBLIC OF INDONESIA

WASTE TO ENERGY GUIDEBOOK

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GUIDEBOOK

EU-Indonesia Trade Cooperation Facility

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WASTE TO ENERGY
GUIDEBOOK

MINISTRY OF ENERGY AND MINERAL RESOURCES
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TCF
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FOREWORD

DIRECTORATE GENERAL FOR NEW AND RENEWABLE ENERGY AND ENERGY CONSERVATION, MINISTRY OF ENERGY AND MINERAL RESOURCES

Praise and gratitude to God Almighty for His abundant grace and blessing, which have enabled the Directorate General of Renewable Energy and Energy Conservation (DG EBTKE) and the Ministry of Energy and Mineral Resources (MEMR), in collaboration with the EU-Indonesia Trade Cooperation Facility project (TCF), to complete this Waste to Energy Guidebook.

The programme of cooperation between DG EBTKE and TCF has provided a vehicle for the carrying out of a number of activities designed to support waste to energy (WtE). These activities have included the provision of technical assistance to local governments, capacity building for government officials and project developers, the organisation of Waste to Energy Week, a study on the harmonisation of regulations for the conversion of waste to energy, an academic review supporting changes to feed-in tariffs (FiTs) for municipal solid waste power plants, socialisation and public dissemination of information related to WtE through the setting up of a dedicated website, the preparation of this guidebook itself and the publishing of the related publication "Mini Guidebook on Waste to Energy".

Using municipal solid waste as a source of electricity is in line with government programmes to encourage the development and utilisation of New Energy and Renewable Energy (EBT), in particular bio-energy, in order to achieve our target of 23% renewable energy by 2025, as stipulated in Government Regulation (PP) No. 79 of 2014, which concerns the National Energy Policy (KEN). The conversion and utilisation of municipal waste to produce renewable energy also have an important role to play in improving the supply of, and access to, energy in the community and will furthermore contribute to reducing greenhouse gas emissions, lowering environmental pollution, enhancing the national economy, and improving public health.

Indonesia's population has risen by 108 million over the last 35 years. This has led to an increase in the volumes of domestic waste being generated. In 2012 the Ministry of Health reported that only about 24.5% of the waste

collected was being processed correctly, while the rest was being burned or dumped into sewers, rivers or the sea. Law No. 18 of 2008 on Waste Management called for all open dump landfills (TPAs) to be closed and replaced with controlled landfills or sanitary landfills. Furthermore, Article 21, paragraph 4 of PP No. 81 of 2012 on the Management of Household Waste and Similar Types of Household Waste stipulated that the responsibility for waste management in Indonesia, including landfill, lies with local government. In response to both the requirements and the significant opportunities set out under this legislation, the MEMR has been encouraging various parties to participate in efforts to convert waste into energy. In parallel, in order to accelerate the development of the WtE sector, the Government has also provided a number of incentives, including the setting of the FiT, the price paid for electricity generated from municipal waste.

It is hoped that the publication of the "Waste to Energy Guidebook" will provide a useful source of reference for all those involved in the development of WtE projects, providing them with detailed information on the management of landfills as sources of raw materials for WtE, the legislative and regulatory background, the technology required, sources of finance and investment, as well as FiTs. The Guidebook is also expected to help project developers and other relevant parties understand the licensing procedures and administrative processes governing development of municipal waste-based power plants operating in Indonesia. It should therefore be an important aid to supporting and developing the renewable energy market in Indonesia, particularly efforts to encourage the utilisation and conversion of municipal waste for energy production on a greater scale.

Finally, I convey my appreciation and gratitude for the cooperation between the DG EBTKE, the MEMR and TCF, which to date has been very beneficial. I also wish to thank all those who have been involved in the preparation of this guidebook and have supported the development and implementation of WtE technology.

Jakarta, December 2015

Director General of New Renewable Energy and Energy Conservation
Ministry of Energy and Mineral Resources Republic of Indonesia
Rida Mulyana

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USING THIS *WASTE TO ENERGY* ***GUIDEBOOK***

We cluster the chapters of the guidebook into five main topics.

Dealing with each topic effectively is essential for successful **Waste to Energy** (**WtE**) projects.

Cluster 1 Landfill management	**Cluster 2 Waste to energy technologies**	**Cluster 3 Project preparation**	**Cluster 4 Procurement and contracting**	**Cluster 5 Operating a WtE project**
Effective landfill management is the essential starting point for WtE projects.	WtE technology must be selected on the basis of practical need, not driven by the agendas of technology suppliers.	Project preparation requires detailed knowledge of the legal environment, and of the potential investment and ownership models.	Once a project has been assessed as feasible, it then enters a contractual process dominated by tendering activities.	Operational effectiveness depends on good management by the local government and the operator
Chapter 1 Landfills in Indonesia	**Chapter 4** Landfill gas harvesting and production systems	**Chapter 6** Pre-feasibility and feasibility studies	**Chapter 9** Models for tendering under PPP (Public Private Partnership) schemes	**Chapter 11** Operating a landfill gas waste to energy facility
Chapter 2 Landfill management/ environmental health and safety	**Chapter 5** Waste to energy technologies	**Chapter 7** The investment and legal basis for waste to energy	**Chapter 10** Financing and financial models, guarantees and sensitivity analysis	**Chapter 12** Managing the risks
Chapter 3 Availability of feedstock		**Chapter 8** Organisation and ownership structures, and PPP at local government levels		

Now go to Cluster 1 Landfill Management

On the following pages we explain the content of the clusters and why each is important for your Waste to Energy strategy.

LANDFILL MANAGEMENT

Here you will find out about the types of landfill currently operating in Indonesia, how to manage the health, safety and environmental issues associated with landfills and how to optimise the supply of waste from landfill needed for waste to energy plants.

Chapter 1: Landfills in Indonesia

- What is the history of landfill in Indonesia?
- What are the key items of legislation applicable to landfill?
- What types of landfill are currently operating in Indonesia?
- How do landfill type and design affect LFG projects?

Chapter 2: Landfill management/environmental health and safety

- What bodies are responsible for landfill management in Indonesia and how are they regulated?
- What waste collection and handling systems are currently in use?
- How can landfill management improve landfill gas production?
- How can adequate and suitable supplies of feedstock be ensured?
- What environmental, health and safety risks do landfills pose?
- What is a sanitary landfill?
- What training is required for landfill operators and workers to ensure safe and environmentally responsible operation?

Chapter 3: Availability of feedstock

- What types of feedstock fuels do WtE facilities need ?
- Does Indonesia produce the right type of waste for WtE plants?
- What are the optimum feedstock characteristics and compositions?
- What type of processing is required to produce the right feedstock?
- How does commercial-scale biogas production work?

WHERE TO FIND THE KEY TOPICS

Now go to Cluster 2
Waste to Energy Technologies

Landfill management is the starting point for waste to energy developments and the basis for appropriate technical solutions.

WASTE TO ENERGY TECHNOLOGIES

Here you will find out about landfill gas harvesting and production systems, the types of waste to energy technologies available and those already operating in Indonesia.

Chapter 4: Landfill gas harvesting and production systems

- How is landfill gas produced from waste?
- What is the composition of landfill gas?
- How is the gas captured and transported to the power plant?
- What treatments and processing are required before the gas can be used?
- What are the most suitable gas harvesting systems for Indonesian conditions?
- How can I estimate and model the amount of landfill gas my landfill can produce?
- How is electricity produced from the gas?

Chapter 5: Waste to energy technologies

- What WtE technologies are available?
- What factors influence the selection of WtE technology?
- How do I ensure that the technologies I am being offered really meet my requirements?
- What are the advantages and disadvantages of incineration, gasification and pyrolysis?

WHERE TO FIND THE KEY TOPICS

Now go to Cluster 3
Project preparation

The right, site-specific gas harvesting and waste to energy technologies must be carefully selected.

PROJECT PREPARATION

Here you will find out how to determine a project's likely success, what government incentives exist to encourage investors and how government-private sector collaboration is promoted under current legislation.

Chapter 6: Pre-feasibility and feasibility studies

- What are pre-feasibility and feasibility studies for?
- What should these studies cover?
- What survey and site data are required to support these studies?
- How much do pre-feasibility and feasibility studies cost and who should carry them out?

Chapter 7: The investment and legal basis for waste to energy

- What laws and regulations govern WtE projects in Indonesia?
- How much investment does your WtE project need?
- What types of investment schemes are available to finance WtE projects?
- How are they applied at national, regional and locals levels?
- What are the tipping fee and the offtake and feed-in tariffs, and how do they operate?
- What types of companies can undertake WtE projects and how are they set up?
- How do existing PPP regulations support the development of WtE projects in Indonesia?
- What forms of government support are available for WtE projects?
- What are the procedures for accessing this support?

Chapter 8: Organisation and ownership structures, and PPP at local government levels

- What are the ownership mechanisms under PPP schemes?
- What is government's role in WtE development (the Institutional Framework)?
- How does government interact with other WtE stakeholders, including the private sector (the Contractual Framework)?

WHERE TO FIND THE KEY TOPICS

Now go to Cluster 4
Procurement and contracting

Successful waste to energy projects require a high level of government and private sector collaboration.

PROCUREMENT AND CONTRACTING

Here you will find out about the legislation governing PPP projects in Indonesia, how to assess a WtE project's financial viability and what documentation is needed at each stage of the bidding cycle, from pre-qualification through to contract implementation.

Chapter 9: Models for tendering under PPP (Public Private Partnership) schemes

- How can private entities bid for PPP projects in Indonesia?
- What legislation governs tendering for PPP projects?
- What are the procedures and requirements at each stage of the tendering process: pre-qualification, bidding, contract implementation?
- What is the difference between a solicited and an unsolicited project?
- How are tender winners announced?
- What challenges are bidders likely to face when tendering for PPP projects in Indonesia?

Chapter 10: Financing and financial models, guarantees and sensitivity analysis

- What income can a WtE project generate?
- What is the cost of setting up a WtE project?
- What financial projections and models are required to ensure project viability?
- What does the pre-feasibility study have to cover?
- What remedial actions are possible, if a project is shown not to be feasible?
- What government incentives are there to develop WtE projects and how do they operate?
- What project documentation is required to arrange financing of WtE projects?

WHERE TO FIND THE KEY TOPICS

Now go to Cluster 5
Operating a WtE project

Investors in WtE need a thorough understanding of the relevant laws and regulations in order to ensure compliance in the bidding cycle.

OPERATING A WTE PROJECT

Here you will find out how to staff, monitor and manage waste to energy facilities efficiently and safely, and how to identify, manage and share commercial and technical risks effectively.

Chapter 11: Operating a landfill gas waste to energy facility

- How can the private sector help operate WtE plants in Indonesia?
- How should WtE plant be staffed efficiently in terms of numbers, the know how and experience required, and roles and responsibilities?
- What plant monitoring and maintenance regimes are required?
- What are the advantages of using private sector operators to run WtE plants?

Chapter 12: Managing and allocating the risks

- How can I identify and manage risk in WtE projects?
- How are the risks shared between government and the private sector?
- How do stakeholders providing project finance view the risk drivers on the government and private sector sides?
- What ways are there to ensure risk is shared effectively between the private sector and government?
- What guidance can be given to government bodies, private companies, lending/financing institutions and other stakeholders on how to allocate, manage and mitigate risk?

WHERE TO FIND THE KEY TOPICS

Now you can begin your journey in WtE. *Good luck!*

Investors, operators and owners of WtE facilities need robust and clear project financing, management and ownership structures, underpinned by fair and equitable risk allocation.

CHAPTER 1

LANDFILLS IN INDONESIA

WHAT THIS CHAPTER IS ABOUT

In this chapter we look at the four principal types of landfill now operating in Indonesia (open dump, controlled, sanitary and modern sanitary) and provide actual examples of current operations.

We consider how the design and operation of landfills critically affect the quality and volumes of landfill gas produced.

THE KEY POINTS

- The laws and regulations governing landfill development in Indonesia. *page 19*
- The types of landfill currently operating in Indonesia. *page 19*
- How landfill design and operation affect the production of landfill gas for waste to energy projects. *page 25*

1.1 A BRIEF HISTORY OF LANDFILLS IN INDONESIA

Landfill infrastructure and Operation and Maintenance (O&M) practices in Indonesia have long been typified by open dumping, low collection rates, underfunding and lack of trained staff. However, like many countries experiencing rapid economic development and improvement, Indonesia has encountered many drivers for change, including improved awareness of environmental and health issues and demands from an increasingly affluent population to be provided with consistent and high-quality solid waste management (SWM) services.

Growing affluence is challenging traditional open dumping landfill operations.

Waste Law No 18/2008 (May 2008) was a key driver for change, its primary aims being the identification of the types of landfill required and their key components, the definition of what levels of environmental and health protection landfills should provide and the allocation of responsibilities for SWM to different levels of government. The legislation is covered in detail in Chapter 7 of the guidebook.

Awareness of the need for effective SWM, as part of a successful public health and environmental management strategy in Indonesia, is constantly rising but there is still room for improvement. In 2013, it was estimated that an average of only 2% of provincial and district budgets was allocated to SWM and that this expenditure was often being used to address other needs, such as the maintenance of parks, and gardens and graveyards. It was also estimated that only 56% of all Indonesians have access to waste disposal services, an increase of 2% based on 2010 data. SWM is just one of many infrastructure elements requiring improvements in Indonesia and, as found globally in similar countries, there is sometimes a perception among government staff responsible for budgets that, as SWM is not a direct contributor to economic growth (unlike roads, ports etc.), it should not be a priority in the budget process. Furthermore, in the face of competing financial demands, the importance of SWM to community wellbeing commonly receives less recognition than other areas, such as water supply and/or sewage management.

Whilst SWM remains a 'cinderella' branch of public infrastructure in Indonesia, the country's national level public officials are up to date in their knowledge of modern, international-standard solid waste facilities.

Technical understanding of modern international-standard solid waste infrastructure is readily available in Indonesia and staff in the Ministry of Public Works (PU), Cipta Karya, are very knowledgeable on modern standards and techniques for sanitary landfills. In addition, in recent years there have been numerous programmes initiated to provide support for the design and construction of modern sanitary landfill facilities. The Government of Indonesia (GoI) is running the PPSP (accelerated infrastructure project) and donors such as AusAid Indonesia Infrastructure Initiative (IndII), KfW, the World Bank, MDF and the UN have invested, continue to invest money and technical resources in upgrading, extending and building new landfills to meet the requirements of Waste Law 18/2008.

1.2 KEY LEGISLATION APPLICABLE TO LANDFILL DESIGN

Recent developments in Indonesian legislation have brought it more into line with what is the norm in Europe, although the power of the legislation and the effectiveness of its implementation, monitoring and enforcement still require improvement. Key legislation includes:

Waste Law No. 18/2008, May 2008 - the first comprehensive national waste law for Indonesia, establishing the principles for public SWM services, providing incentive and disincentive mechanisms, defining how responsibilities for SWM are shared between the various levels of government, facilitating community-based SWM systems and private sector participation in SWM and setting out the penalties for disobeying the law.

Waste law 18/2008 sets out the principles for SWM services in Indonesia, defining incentives and responsibilities and facilitating community and private sector participation.

Water Supply System Development Government Regulation 16/2005 - has the most relevance to defining what landfill design is required in different locations. Articles 19-22 of the regulation require that each landfill (TPA) must contain buffer zones and follow controlled disposal methods. For large cities/metropolitan areas this equates to providing Sanitary Landfill Facilities, whereas cities of moderate/small size require Controlled (engineered) Landfill Facilities.

Household Waste Management Government Regulation No. 18/2012 - focuses on preserving environmental standards through the management of waste as a resource. The regulation allows for targets to be set for waste reduction, emphasises waste segregation at source and requires consideration to be given to recycling and reuse in the design of products and packaging.

In reality, how a landfill is managed is the decisive factor in determining what type of landfill it is, irrespective of its actual design or construction.

Household Waste Handling Infrastructure Ministry of Public Works Regulation No. 03/PRT/M/2013 - focuses on the planning for, and implementation of, holistic municipal solid waste (MSW) master plan solutions at a regional or local level and covers the general planning of MSW services, landfill infrastructure design standards, the provision of MSW processing/disposal facilities and the closure/rehabilitation of landfills.

Chapters 7 and 9 look at these laws and regulations in greater detail.

1.3 TYPES OF LANDFILLS IN INDONESIA

The table below provides an overview of the different types of landfill in Indonesia, with the subsequent sub-sections giving practical examples of the different types and providing summaries of their key features. An important point to understand is that it is the manner in which a landfill is managed that ultimately decides what type of landfill it is. A landfill may be designed and constructed as a 'Sanitary Landfill', but if it is not maintained or managed to ensure it provides the environmental and health protection it is designed for, it may, in practice, be little more than an 'open dump'.

Component	Detail	Open Dump	Controlled Landfill	Sanitary Landfill	Modern Sanitary Landfill
Cell Lining	Required?	N	Y	Y	Y
	Low Permeability Liner (<10-8m/sec) (Compacted Clay, high-density polyethylene (HDPE), geosynthetic clay liner (GCL)	-	Y	Y	Y
Leachate Collection	Required?	N	Y	Y	Y
	Gravel liner > 20cm depth	-	Y	-	-
	Gravel liner > 20cm depth with perforated pipes	-	-	Y	Y
Leachate Treatment	Required?	N	Y	Y	Y
	Passive system	-	Y	-	-
	Active system - recirculation, mixers, aerators, biological/ chemical treatment	-	N	Y	Y
LFG Control	Required?	N	Y	Y	Y
	Passive venting	-	Y	-	-
	Recovery and collection systems	-	N	Y	-
	WTE utilisation	-	N	-	Y
Waste Cover	Required?	N	Y	Y	Y
	Weekly cover required?	-	Y	-	-
	Daily cover required?	-	N	Y	Y
Heavy Equipment	Recommended?	N	Y	-	-
	Required?	N	N	Y	Y

***Table 1.1**: Key design and operating elements required in Indonesian landfills*

The next table provides an indication of the types and numbers of landfills believed to be operating in Indonesia in 2007, prior to the introduction of Waste Law No. 18/2008.

Type of Landfill	Number of Landfills	Area of Landfills (Ha)
Open dump	445	1,433
Controlled landfill	52	483
Sanitary landfill	24	182
TOTAL	521	2,098

***Table 1.2:** Summary of landfills in Indonesia in 2007*

We now look at each of these landfill types in turn.

Traditional/Non-sanitary/Open Dump Landfill

Traditional, or non-sanitary, landfills can also be considered as open dumps and are common throughout Indonesia, especially in small districts. Although the Solid Waste Management Law UU18, 2008 (Art. 44) requires that all open dumps should have a closure/upgrade plan within one year and that the closure or upgrading of all open dumps should be completed within five years, these targets have not been fully achieved.

Open dumps have little or no design, equipment, budget or O&M planning. Engineered, lined cells and leachate collection and treatment systems are absent and tipping takes advantage of the natural contours of the site. The dumping of waste is not coordinated or planned, with drivers typically tipping their waste loads in the location most convenient to them. The covering of waste deposits is extremely unlikely to occur and this is not helped by the likely complete absence of any equipment to compact or cover the waste. No fencing or control of access means that scavengers and livestock have free run across the sites. Fires are common across open dumps, often set off by local scavengers to aid recovery of metals by burning plastic cable casings etc.

Traditional, non-sanitary landfills are common throughout Indonesia. They lack design, equipment, 0&M planning and access control, with largely uncontrolled tipping and often no covering of waste.

This site was located in an isolated position with no site or environmental management elements.

The site was closed as part of the UNDP-led Tsunami Recovery Waste Management Programme (TRWMP). This photo was taken in 2008, just before levelling and covering of deposited wastes was completed.

***Figure 1.1**: The former Ujung Sikuneng landfill in Nagan Raya, Aceh*

Moving on from the very small-scale landfill identified above, the Rawa Kucing landfill in Tangerang is a very large landfill that currently covers approximately 35 hectares (~20 ha tipped) and is located less than 2 km away from Jakarta's Soekarno Hatta International Airport and adjacent to the Cisadane River. Rawa Kucing is interesting in that, since it started operation in 1993, it has predominantly operated as a non-sanitary landfill serving the whole of Tangerang city, which comprises 13 districts covering an area of 184 km^2 and is home to a population of 1.9 million.

The site was previously used as a sand quarry and the majority of deposited wastes were tipped straight into the pits, which extend to between 12 m and 30 m below the original ground level. This represents a typical/traditional Indonesian, non-sanitary landfill – planned to meet the needs of a city but incorporating little or no environmental protection measures and managed on a low budget and with insufficient technical skills.

The Rawa Kucing landfill outside Tangerang city started out as a typical Indonesian non-sanitary landfill, constructed to meet the needs of the city but offering little or no environmental protection.

The 35 ha site consists of a 20 ha non-sanitary landfill area (in the foreground), tipped between 1993 and 2014, and a new 2.3 ha sanitary cell (in the background) operated in 2014 and 2015.

The site should have been upgraded to a sanitary landfill by 2013 but still lacks effective landfill gas (LFG) and leachate management options. In addition, the waste tipping faces are high and wide and without daily cover.

Given the daily inputs of waste (around 800 tonnes per day (tpd)) and the typically high organic content of Indonesian waste (around 60%), the potential for LFG utilisation is high. This potential is currently limited by the high leachate levels. However, the area is receiving help and support to improve waste infrastructure and knowledge.

***Figure 1.2**: Rawa Kucing landfill, Tangerang City, Java*

There is an on-going project to provide a detailed engineering design (DED) for new sanitary cells, a compliant and capable leachate treatment plant (LTP) and associated resource recovery facilities including a material recovery facility (MRF) and a waste to energy (WtE) facility. These planned improvements will benefit the site and the city but the tipping practices applied in the past mean that Rawa Kucing is likely always to remain a part non-sanitary landfill and part controlled/sanitary landfill.

Controlled landfills for small to medium-sized cities should include lined cells, leachate collection and treatment, buffer zones, gas venting or flaring and regular covering of the waste.

Controlled Landfill

A controlled landfill is required for cities of a moderate/small size and is expected to include low-permeability lined (compacted clay, HDPE, GCL) cell(s), a leachate collection system, a passive leachate treatment system, a buffer zone, gas venting/flaring, waste cover every seven days and some heavy equipment (HE) in the shape of a bulldozer and/or excavator for disposal operations.

Constructed in 2006 as part of the UNDP TRWMP, this emergency landfill consisted of a single cell formed by excavation and the compaction of low-permeability soils.

Tipping was managed from a single defined tipping location. Wastes were subsequently compacted and covered with soil, although the frequency of this was not always once a week.

Passive gas vents were installed, as was a three-pond, gravity-fed passive leachate treatment system. Solutions such as this are often the most appropriate in remote locations where access to more mechanical/sophisticated treatment options is restricted, budgets are constrained, and the local knowledge to operate them is limited.

***Figure 1.3**: The Batee Puteh landfill in Nagan Raya, Aceh*

The Nagan Raya landfill in Aceh highlights the potential issues with landfill in Indonesia. Built after the 2004 tsunami, this facility was intended and designed to operate as a sanitary landfill but the as-built design is actually operating more like a controlled landfill.

Although designed in line with the concept of a sanitary landfill, the Batee Puteh landfill more closely matches the requirements of a controlled landfill in that it has passive leachate (gravity-fed treatment ponds) and landfill gas (passive venting) management systems. In addition, whilst HE was available to facilitate the compaction and covering of wastes, the HE was infrequently used and cover only sporadically applied – an example of the importance of landfill management and operation to a successful and safe landfill site. This site had a very small waste capacity (around 4,500 m^3), but it is representative of the type of smaller controlled landfills encountered in Indonesia and provides a good visual example of what can be expected at a landfill of this type.

The next example is also from Nagan Raya, Aceh and was also constructed after the 2004 tsunami, this time by Badan Rehabilitasi dan Rekonstruksi (BRR) – the GoI's Rehabilitation Agency. The Alue Le landfill was designed to provide secure waste disposal facilities for the district in the medium- to long-term and again was intended to serve as a sanitary landfill. In reality, however, the as-built design was more like a controlled landfill. This example is given here to provide an indication of a slightly more engineered landfill than encountered

at Batee Puteh, but also to highlight some potential technical limitations and issues with landfill construction in Indonesia that should be noted.

This site was constructed in 2008 as part of the BRR initiative to provide improved waste infrastructure in Aceh.

The site is equipped with a shallow (<2 m) HDPE-lined single waste cell and basic, gravel-filled leachate collection trenches and passive gas vents.

The HDPE liner material used was very thin and unprotected and was installed by staff with little experience of using the product. Tears in the liner were visible before any waste was deposited.

Although the desire to provide a controlled landfill environment was sound, design and construction qualities were poor.

Figure 1.4: *The Alue Le Landfill in Nagan Raya, Aceh*

Sanitary Landfill

A sanitary landfill is required for large cities/metropolitan areas (population over 0.5 million) and should include low-permeability lined (compacted clay, HDPE, GCL) cell(s), a leachate collection system, a gravel liner with minimum 20 cm diameter perforated pipes, an active leachate treatment system (recirculation, mixers, aerators, biological/chemical treatment etc.), a buffer zone, a gas recovery and flare system, daily covering of wastes and the provision of HE.

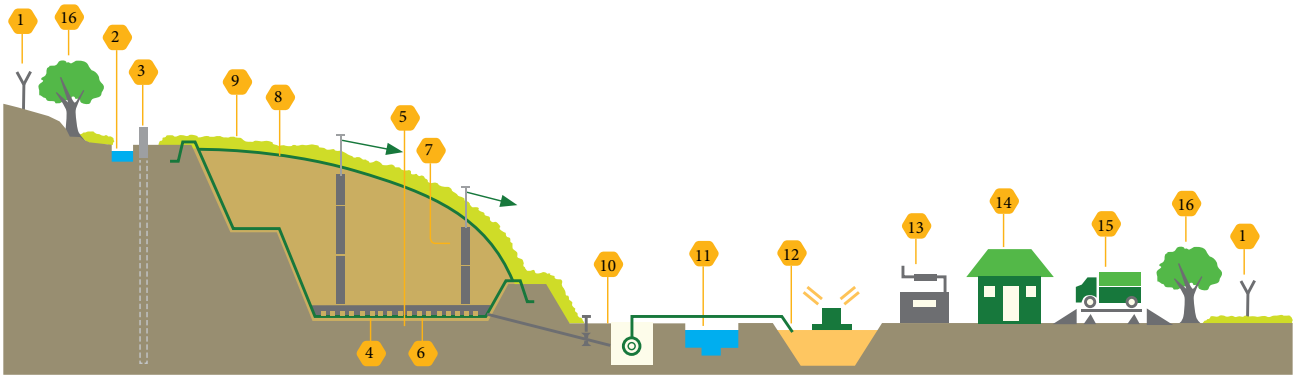


Figure 1.5*: Typical schematic of a sanitary landfill (including optional LFG utilisation)*

1. Perimeter Fencing
2. Surface Run-off Drainage
3. Groundwater Monitoring
4. Lining System
5. Leachate Collection System
6. Leachate Drainage Pipe
7. Gas Well for Landfill Gas
8. Capping
9. Restored Surfaced
10. Leachate Pumping Sump
11. Perimeter Drainage System
12. Leachate Treatment Plant
13. Landfiill Gas Power Generation
14. Operation Office
15. Weighbridge
16. Screening Trees

Landfilling here is reported to have commenced in 2001 and was initially operated by the local government. Since 2012, the landfill has been operated by PT Sumber Organic (PT SO) under a 20 year build-operate-transfer (BOT) contract. The landfill has been divided into seven tipping zones covering a combined area of around 37 ha. The site receives approximately 1,500 tpd and the maximum capacity of all tipping areas has been estimated at around 3 million m^3.

The site has an active LTP (chemical/biological treatment) and dedicated HE (excavators, dozers and loaders). As with other sanitary landfills in Indonesia, it is unlikely that the requirement for the daily covering of wastes is rigorously adhered to.

Although now categorised as a 'sanitary' landfill, Benowo was constructed along the principles of a 'controlled landfill' with engineered but unlined cells. As part of their operational agreement, PT SO has contractual obligations to improve the site infrastructure and to operate the landfill as a 'sanitary' landfill.

The PT SO website states that, from June 2014, the new LTP plant would be able to meet effluent discharge standards and that by October 2014 an LFG WtE system would be able to deliver stable power to the grid – a requirement for 'modern sanitary' landfills.

***Figure 1.6**: The Benowo Landfill in Surabaya, Java*

Modern Sanitary Landfill

The Bangli landfill is intended to serve as a pilot project for replication throughout Indonesia.

A modern sanitary landfill is expected to operate with a bigger emphasis on resource recovery and the protection of the environment and so is likely to be co-located with recycling/recovery facilities and to focus on the production of energy from waste. These types of landfills require a greater degree of planning as to how they will be operated and also where they sit within the overall SWM collection and disposal framework. There are very few current examples in Indonesia, although this is the type of landfill that is aspired to for large cities/metropolitan areas and there are several design projects currently in progress for areas such as Tangerang and Balikpapan.

The Bangli regional landfill is located about 45 km northeast of Denpasar, the provincial capital of Bali. It was constructed in 2007/2008 and became operational in 2009.

The landfill covers an area of approximately 4.75 ha with a total lifespan in the region of 10-15 years.

When funding for the Bangli landfill project was approved by GoI, the Ministry of Public Works decided that it should become the first sanitary landfill in Indonesia to be designed with a modern lining system, serving as a pilot project that could be referenced throughout Indonesia.

***Figure 1.7**: The Bangli regional landfill in Bali*

1.4 IMPLICATIONS OF LANDFILL TYPE AND DESIGN FOR LFG PROJECTS

The issue of landfill management is covered in more detail in Chapter 2. Here we look at the significance of landfill type and size for potential LFG projects.

While the nature of typical waste in Indonesia offers great potential for realisation of LFG WtE projects, lack of data means that full and extensive baseline surveys will be required to identify suitable sites and acceptable ROI.

Landfill is the dominant form of waste disposal in Indonesia and will continue to be so for the foreseeable future. Indonesian MSW has a high organic content (around 60%) so there is a large amount of landfill waste producing LFG. The potential for LFG WtE projects in Indonesia is therefore also high but there are many issues that need to be resolved before a successful LFG WtE project can be implemented.

The central issue is that there is very little consistency from one landfill in Indonesia to another in terms of design, build and operation. Identification of credible LFG WtE projects will therefore require a significant amount of research and effort to find the landfills with the highest WtE potential. Nor can potential operators and investors expect there to be much data available on current gas production at landfills in Indonesia as environmental monitoring is not as widespread as in some Western countries. It should be assumed, therefore, that full and extensive baseline surveys will be required.

The table below is taken from the Global Methane Initiative's 2012 'International Best Practices Guide for Landfill Gas Energy Projects' and shows, on a qualitative basis, how some basic elements of landfill design and operation can impact the potential for LFG WtE projects in Indonesia.

Landfill component	Status of landfill component	Impact on LFG generation	Impact on % of methane in LFG	Impact on LFG collection efficiency
Bottom liner	none/inadequate	no impact	no impact	decreases
	adequate	no impact	no impact	increases
Leachate collection/removal system	none/inadequate	decreases	decreases	decreases
	adequate	increases	increases	increases
Final capping	none/inadequate	decreases	decreases	decreases
	adequate	increases	increases	increases
Planning filling sequence	none/inadequate	decreases	decreases	decreases
	adequate	increases	increases	increases
Waste compaction	none/inadequate	decreases	decreases	decreases
	adequate	increases	increases	increases
Daily and/or intermediate cover used	none/inadequate	decreases	decreases	decreases
	adequate	increases	increases	increases
Slopes	none/inadequate	decreases	decreases	decreases
	adequate	increases	increases	increases
Fire control	none/inadequate	decreases	decreases	decreases
	adequate	increases	increases	increases

***Table 1.3**: Qualitative assessment of how design and operational elements impact LFG*

The potential for projects at open dumps is generally lower than for controlled or sanitary landfills, since the lack of any form of capping system means that passive LFG venting to the atmosphere and high leachate levels will be significant. Coupled with the high moisture content of Indonesian waste and the tropical (warm and wet) climate, waste degradation and the associated production of LFG occurs more quickly in Indonesia than in Europe, North America or other more temperate climates. A lot of open dumps are small, with the result that the return on investment (ROI) at these sites is probably prohibitive. Open dumps do not generally have a pre-installed LFG collection and extraction system – hence investment costs are likely to be higher. The burning of waste at open dumps is common and can also reduce the LFG potential.

While Indonesia's climate means that waste degradation to produce LFG occurs relatively rapidly, the small size of many of the country's open dumps, their lack of gas collection/ extraction systems and the frequent uncontrolled burning of the waste by scavengers present disincentives to investment.

Controlled and sanitary landfills are required to have a minimal level of LFG infrastructure – passive vents in the case of controlled landfills and recovery and collection systems in the case of sanitary landfills. Passive vents may have limited benefit when it comes to utilising LFG but they do at least provide a mechanism for testing or monitoring LFG levels. Recovery and collection systems can prove more beneficial, but consideration should be given to the appropriateness of the system design and the quality and reliability of construction materials and of the installation itself. There is a possibility that such pre-installed systems are not suitable for LFG utilisation and, in reality, they were probably only ever designed to support limited LFG flaring operations.

As indicated above, open dumps and/or poorly operated controlled/sanitary landfills can present barriers to the development of successful/sustainable LGF WtE projects. In Indonesia, the move towards requiring minimum standards of landfill design (controlled/ sanitary) and improved landfill operational and management practices will help to improve the potential for LFG utilisation projects but it is important to always be aware of how basic errors in landfill design or the inability to follow landfill operational protocols can reduce or eliminate the potential financial rewards from LFG WtE projects.

Current schemes to upgrade open dumps present investors with a valuable opportunity to partner and build relationships with operators in the design and expansion of existing facilities, advising on the best lfg systems to install.

As the upgrading of open dumps is still underway, there will be opportunities to partner in such design and expansion projects and help to direct how the landfill is designed and what LFG systems can be installed. This will likely be more productive than relying on retrofitting LFG systems and will also facilitate the building of relationships with those responsible for planning and operating waste disposal facilities. Those types of relationships will prove essential in Indonesia when it comes to securing business deals and also in educating those directly responsible for design, operation and maintenance of landfills.

Chapter Checklist	✔
Now that you have read this chapter:	
Are you now familiar with the legislation governing landfill in Indonesia?	
Do you know the types of landfill currently operating in Indonesia and how their key features affect landfill gas production?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 2

LANDFILL MANAGEMENT/ ENVIRONMENTAL HEALTH AND SAFETY

WHAT THIS CHAPTER IS ABOUT

In this chapter we detail Indonesia's legal framework governing solid waste management (SWM).

We review the full SWM process, from collection through to disposal.

We examine how landfills in Indonesia are regulated and how waste collection and segregation, and landfill management impact on waste to energy (WtE) projects and visa-versa.

We consider how waste can be seen as a resource not a burden under an effective 3R (reduce, re-use, recycle) strategy.

We look at the environmental, health and safety issues posed by landfills and the training required for those operating them.

THE KEY POINTS

- How landfills are regulated in Indonesia and what government bodies are responsible. *page 28*
- The types of waste collection, transfer, handling and treatment systems currently in use in Indonesia. *page 31*
- Ensuring adequate and suitable supplies of waste 'feedstock' for WtE through better waste handling/processing and landfill management. *page 34*
- The training required by landfills operators to ensure that sites comply with health, safety and environmental regulations. *page 43*

If operated and managed well MSW management systems improve the quality of life for all in the community. Moreover, waste is being increasingly viewed as a resource not a burden.

2.1 LANDFILL MANAGEMENT ENTITIES IN INDONESIA AND THEIR LEGAL STATUS

The collection and disposal of waste is an essential community service – it is as important to modern life as water and energy. If waste is not collected, treated and disposed of properly then community health, safety and the environment suffer. Open dumping causes air and groundwater pollution, attracts flies and vermin and transmits disease. Uncontrolled dumping blocks drains, creating breeding grounds for mosquitos and causing flooding. Burning of waste releases airborne toxins, and decomposing waste releases greenhouse gases.

See chapter 9 for a detailed legal and regulatory review.

The key law regulating the method/entity by which landfills in Indonesia are managed is Government Regulation (GR) No.81 Year 2012 concerning Household Waste Management (GR 81/2012). Article 22 (2) of this regulation requires landfills to be managed by local government, which has delegated powers to establish institutions specifically to manage the entire SWM system, inclusive of landfills. Such institutions are listed in table 2.1 below.

Detail	Open Dump	Controlled Landfill	Sanitary Landfill
Dinas Kebersihan (DKP), Satuan Kerja Perangkat Daerah (SKPD)	Regulation No. 41 Year 2007 concerning Local Governmental Organisation (MOHAR 41/2007).	Local Sanitary Agencies, established under local regulations governing their structure, status and principal duties; governed by the head of the local government; responsible for all aspects of SWM and landfill management.	These are the most common form of SWM agency in Indonesia, found in all provinces.
Unit Pelaksana Teknis Dinas (UPTD)	Article 7 (6) of MOHAR 41/2007.	Technical Implementing Units, established within a Dinas to implement technical, operational and supporting activities for waste management services. Often used by two or more municipal/district authorities to manage a shared regional landfill facility.	West Java Province Local Waste Management Agency or locally known as Balai Pengelolaan Sampah Regional Jawa Barat.
Badan Layanan Umum Daerah (BLUD)	Article 14 of the Minister of Home Affairs Regulation No.33 Year 2010 concerning Waste Management Guidelines (MOHAR 33/2010).	A Local Public Service Agency, used to manage large regional landfill facilities. A BLUD may cooperate with third parties (private companies) in service delivery operations.	not yet established
Perusahaan Daerah (PD), Perusahaan Umum Daerah (PUD), Perusahaan Perseroan Daerah (PPD)	Law No. 5 Year 1962 concerning Regional Corporation (Law 5/1962); Law No 23 Year 2014 concerning Local Government (Law 23/2014)	Local government-owned enterprises or local limited liability companies, involved in managing landfills and providing municipal solid waste (MSW) services at the municipal/city level.	PD Kebersihan in the city of Bandung, PD Kebersihan in the city of Balikpapan, PD Kebersihan in the city of Makassar and PD Jaya covering Jakarta.

Table 2.1 *Indonesian SWM legal entities*

Dinas Kebersihan (local sanitary agencies) look after most SWM activities in Indonesia. We look at how they operate and what they do.

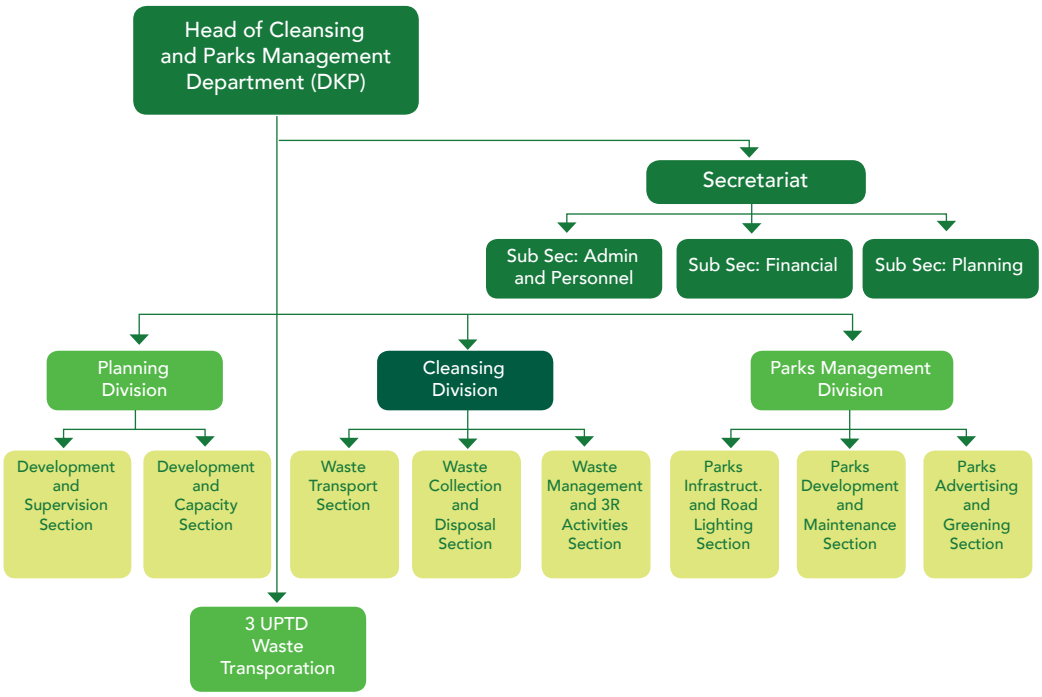
2.2 MANAGEMENT ROLES AND RESPONSIBILITIES

As the Dinas Kebersihan is the most common local government entity with responsibilities for MSW/SWM in Indonesia, we consider here how it operates and what its responsibilities are.

Responsibilities within a DKP/DKPP are typically broken down into divisions (Bidang Kebersihan) and sub-divisions (Sub-Bagian), as shown in the example below for Tangerang city DKP. Tangerang comprises 13 districts, covering an area of approximately 185 km2 with a population of around two million.

The Dinas Kebersihan is a technical unit responsible for cleansing services; it typically takes one of two forms:

- *Dinas Kebersihan Dan Pertamanan (DKP) – a cleansing services unit with additional responsibilities for public parks; and*
- *Dinas Kebersihan, Pertamanan Dan Pemakaman (DKPP) – which is the same as a DKP except that it has additional responsibilities for cemeteries.*



Tangerang City provides a useful example of how a Dinas Kebersihan is structured and how responsibilities are allocated.

***Figure 2.1**. Tangerang city DKP organisational structure and allocation of responsibilities*

The organisational structure of the Tangerang DKP was established in accordance with Mohar 41/2007 and the Local Regulation (Perda) of the City of Tangerang No 33/2008. The DKP has a head of department (Kepala Dinas), a secretariat that supervises three administrative sections (personnel, finance and planning) and three divisions with responsibilities for planning, waste management/cleansing and parks.

In Tangerang, the head of the DKP has the following typical core functions, which are common to most DKPs in Indonesia:

- managing the Dinas strategic plan and complying with the vision, mission and programme of the mayor with regard to SWM and parks management;
- preparing and managing annual work plans and their associated budgets;
- managing DKP operations;
- overseeing the various functional tasks of the Dinas; and
- preparing the annual accountability report, or LAKIP, for the Dinas.

The Bantar Gebang landfill (BGL) is a variation in the typical format of Dinas Kebersihan and MSW/SWM responsibilities normally encountered in Indonesia. The BGL receives waste from, and is administered by, DKI jakarta but is located in an area under the jurisdiction of Bekasi City (Kota Bekasi), West Java province.

Within the DKP, the Planning Division is tasked with the technical planning and implementation of activities to increase community participation in SWM improvements and for capacity building to improve the standards of re-use, transportation and disposal of waste within the DKP.

The Waste Management/Cleansing Division is split into three sub-divisions, their respective responsibilities being waste transportation, receipt and disposal of waste at landfill (TPA) and 3R activities. These responsibilities are largely self-explanatory; although it is worth pointing out that the Waste Transportation sub-division is also responsible for transportation of waste to and from local transfer stations (TPS). This sub-division has also set up three UPTDs that operate as maintenance workshops for waste collection/transportation assets in each of the three waste collection areas of the city. The 3R activities sub-division has diverse responsibilities, including the coordination of 3R activities at the landfill (which also involves managing waste scavengers), promoting products created from waste, increasing community and business awareness of the benefits of 3R and managing the planning and construction of integrated waste management facilities (TPST), which are normally waste

recovery/recycling/WtE operations directly connected to landfills. In 2012 it was estimated that the Waste Management division had a staff of around 800, made up of civil servants (128), contract workers (112) and part time staff (560).

2.3 WASTE COLLECTION PROCESSES AND MANAGEMENT

In order to illustrate a fairly typical waste collection and handling system, we will use the example of Tangerang City, which is currently exploring ways to improve waste collection and recycling and to increase community participation in 3R activities. Figure 2.2 below shows a basic flowchart indicating the various sources of waste and the ways in which the waste was handled in the city in 2012.

Waste collection and management processes in Indonesia are more varied and basic than those normally encountered in Europe.

Residential Waste

It can be seen from the top of Figure 4.2 that there are two options for residential waste collection, namely 'collection points' or 'containers'. Daily mixed MSW collection is carried out in each of the three service areas that make up Tangerang City. Door to door service (containers) is mainly restricted to high-income areas. Direct communal service (i.e. private waste collectors and/or residents bringing their waste to collection points/TPS) is practised in most middle- and low-income areas. Approximately 75% of the city is covered in this way. The waste is ultimately collected from the TPS and transported to the Rawa Kucing landfill using 6 m3 dump trucks.

In Tamerang City there are two options for residential waste collection, namely 'collection points' or 'containers'.

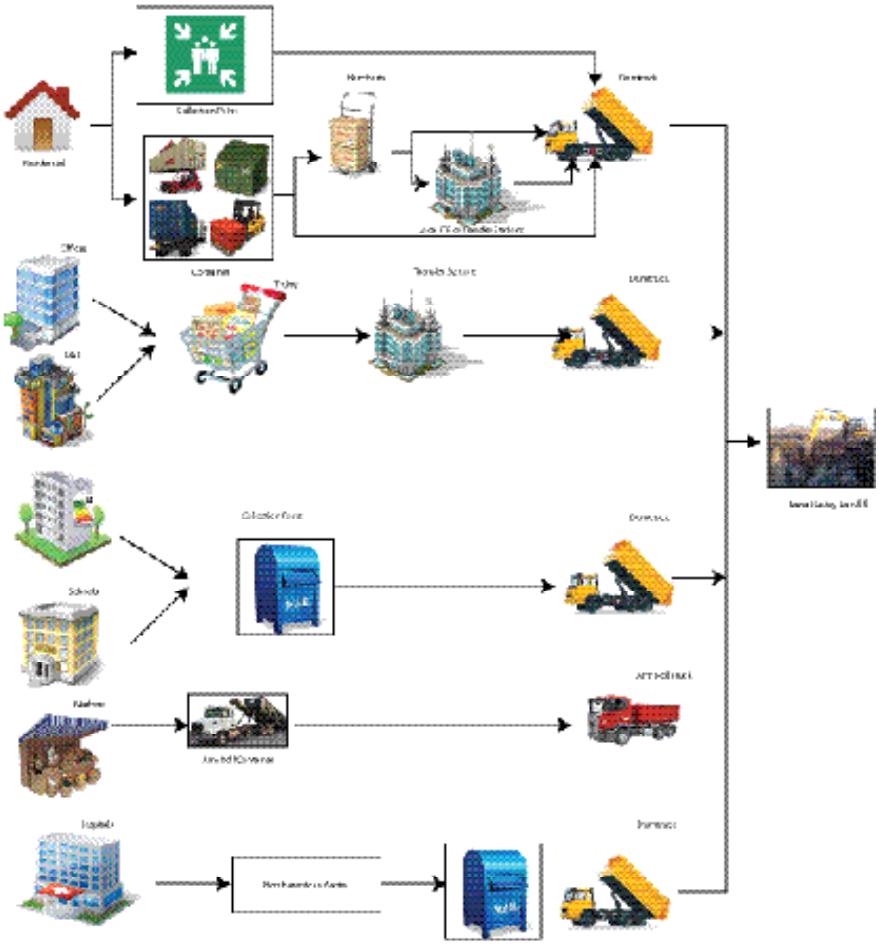


Figure 2.2 *Flowchart of SWM collection and transportation processes in Tangerang City (CBIA)*

Non-residential Waste
A daily collection of mixed MSW follows the communal collection system using 6 m3 dump trucks. Here, waste is collected from various types of TPS (fixed brick/concrete, steel, plastics, etc. of differing sizes/capacities/designs).

Market Waste
This waste is collected daily under the communal collection system, either using 6 m3 arm-roll containers or trucks.

Figure 2.3: *Residential waste household collection bin (indonesiaituaku.blogspot.com)*

Figure 2.4: *TPS in Pasar Elang market, North Jakarta (beritajakartautara.blogspot.com)*

2.4 INTERMEDIATE HANDLING OPTIONS AND TERMINOLOGY

The terminology surrrounding waste treatment in Indonesia can be confusing. Here we briefly explain the various techniques, including waste banks…

Many different technical terms are used in Indonesia to describe the various forms of transfer stations/intermediate treatment facilities, and this can be confusing. Below is a summary of the main terms likely to be encountered, along with examples from Tangerang, where applicable, including future plans for improvements to the city's waste handling systems.

Waste Banks

To increase participation in recycling and improve recycling rates, community-based waste banks (CWB) were introduced to Tangerang in 2011. These are essentially small-scale operations, consisting of segregated bins to which community members can bring and sell their recyclables. It has been reported that more than 300 such waste banks are already operating.

…transfer stations…

Recyclables collected by waste banks can be sold directly to local waste dealers or can be forwarded to the central waste bank (CWB) located at the Rawa Kucing Landfill, which conducts sales negotiations with local waste dealers before redistributing the funds to those waste banks that provided the recyclables.

Transfer Station - SPA

An SPA (Stasiun Peralihan Antara) or transfer station is typically defined as a facility where MSW is unloaded from collection vehicles and briefly held before being reloaded onto

larger, long-distance transport vehicles for shipment to a landfill or other treatment or disposal facilities. Under PerMen PU No. 03/2013 (Article 31), an SPA is defined as having the capability for compaction and, as a minimum, being capable of containing and storing leachate. SPAs can come in two forms, namely:

- city-scale SPAs, with minimum areas of 20,000 m^2 and capacities of 500 tonnes per day (tpd), which can be equipped with waste processing facilities and (under Art. 1.15) allow the transfer from small to larger vehicles, as required for a district/city that has a landfill over 25 km away; or
- residential-scale SPAs (formerly known as UPS), which are covered under Art. 31 and have minimum areas of 600 m^2 and capacities of 20-30 tpd.

Temporary Solid Waste Collection Point - TPS

…collection stations, storage and recycling points…

TPSs (Tempat Penampungan Sementara) typically consist of simple open areas, concrete storage containers or areas provided with arm-roll containers into which households, informal sector waste collectors or DKP staff bring waste for subsequent collection and transportation by the municipality. Under PerMen PU No. 03/2013 (Article 20) the typical area required for a TPS is < 200m^2.

Typical TPSs are concrete bunkers with volumes of approximately 2m^3, each serving some 300 households/Rukun Warga (RW or community association).

Temporary Solid Waste Storage and Recycling Point - TPS-3R

A TPS-3R (Tempat Pengolahan Sampah Dengan Prinsip 3R) is similar to a TPS but can cover an area > 200m^2 and be capable of sorting waste into five defined categories and of conducting basic waste 3R activities. PerMen PU No. 03/2013 (Article 30) allows for their integration with community-based waste management systems, such as waste banks. Figure 2.5 (below) shows how locally collected waste enters the TPS-3R and is manually sorted into three waste streams; organics for composting; inorganic recyclables (plastics, paper/card, metal, glass, fabric etc.) for resale; and residue waste destined for final landfill disposal.

Integrated Waste Processing/Treatment Facility - TPST

…and integrated waste processing and treatment.

A TPST (Tempat Pengolahan Sampah Terpadu) undertakes waste recovery, recycling, separation, collection, conversion and final processing. Under PerMen PU No. 03/2013 (Article 32) they are defined as covering an area > 20,000m^2, and can be co-located at a landfill or elsewhere. They can also include WtE facilities.

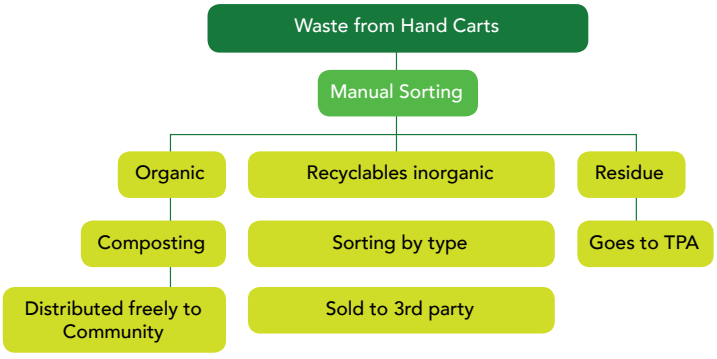


***Figure 2.5**: Flowchart showing how TPS-3R currently operates*

2.5 BEST PRACTICE IN LANDFILL MANAGEMENT AND ITS IMPACTS ON LFG/WTE POTENTIAL

Here we look at a range of landfill management practices and examine how they impact on WtE/ LFG potential. This should be read in conjunction with chapters 4 and 5 to fully understand the interrelations between landfill management and WtE projects.

Landfill gas (LFG) is produced during the decomposition of organic matter and is made up of a mixture of many different gases, with carbon dioxide and methane normally predominant. Carbon dioxide and methane are both greenhouse gases (GHG), methane being particularly aggressive with a GHG potential 250 times higher than carbon dioxide. Landfill gas has an odour, can travel or migrate from waste cells to other areas (even beyond the landfill site boundary), is dangerous to inhale in confined spaces and can cause explosions or fires if concentrations are allowed to build up.

Table 2.2 below, modified from the Global Methane Initiative's 2012 'International Best Practices Guide for Landfill Gas Energy Projects', indicates qualitative factors related to landfill design and/or management that could impact the potential for LFG WtE projects in Indonesia.

Landfill component	Status of landfill component	Impact on LFG generation	Impact on % of methane in LFG	Impact on LFG collection efficiency
Bottom liner	None/Inadequate	No Impact	No Impact	Decreases
	Adequate	No Impact	No Impact	Increases
Leachate management	None/Inadequate	Decreases	Decreases	Decreases
	Adequate	Increases	Increases	Increases
Final capping	None/Inadequate	Decreases	Decreases	Decreases
	Adequate	Increases	Increases	Increases
Planning filling sequence	None/Inadequate	Decreases	Decreases	Decreases
	Adequate	Increases	Increases	Increases
Waste compaction	None/Inadequate	Decreases	Decreases	Decreases
	Adequate	Increases	Increases	Increases
Daily and/or intermediate cover used	None/Inadequate	Decreases	Decreases	Decreases
	Adequate	Increases	Increases	Increases
Slopes	None/Inadequate	Decreases	Decreases	Decreases
	Adequate	Increases	Increases	Increases
Fire control	None/Inadequate	Decreases	Decreases	Decreases
	Adequate	Increases	Increases	Increases

Table 2.2: Qualitative assessment of how design and operational elements impact LFG

Well-designed and well operated sanitary landfills of the scale found in Indonesia are highly likely to be able to generate LFG in quantities that are sufficient for power generation projects.

It is vital that landfill designers and operators understand how the interconnecting elements of landfill design and operation can affect the sustained production of LFG, the methane content of LFG and the collection efficiency of LFG harvesting systems.

All the factors discussed below will contribute to the landfill's being able to operate for as long as possible, with minimal environment and public health impact, and maximum LFG production potential.

Landfill Cell Bottom Liner

Although a landfill bottom liner has the primary aim of preventing/minimising soil and groundwater pollution by containing leachate produced within a landfill, the liner also has a role in LFG production potential by acting as a barrier to LFG migration. This is especially important after a landfill has been capped/closed, since closed landfill cells contain gas, which, if not properly controlled, can migrate down or laterally under pressure and may eventually be released into adjacent properties or underground structures causing a risk of fire or explosion. Furthermore, any uncontrolled release of LFG represents a potential loss in revenue from LFG utilisation.

Leachate Management

Modern sanitary landfills are constructed with a leachate collection blanket that incorporates collection pipe networks that ultimately feed to a Leachate Treatment Plant (LTP). All of this is designed to ensure that leachate is collected and treated to minimise any impacts to the local population and/or environment. Poorly designed and maintained leachate collection systems are prone to blocking, causing leachate levels to build up within the landfill, flooding LFG collection wells and saturating waste, resulting in blockages of both the production and flow of LFG.

Inadequate leachate management/treatment poses an environmental and public health risk from contamination of surface or groundwater, affecting water supply to local populations and damaging the local flora/fauna.

Final Capping of Wastes

The final capping system for a landfill is typically specified as part of the detailed engineering design (DED) and can consist of layers of natural soils or synthetic materials (high-density polyethylene (HDPE) etc.) with low permeability, ensuring that infiltration of rainfall and associated leachate generation is minimised, air ingress into the waste mass is reduced, surface water drainage/runoff is managed and that uncontrolled/passive LFG emissions are minimised. All these benefits help to maximise LFG potential. In addition, LFG power projects extract gas by applying a vacuum to the well-field; the low permeability cap ensures the vacuum is maintained, gas is extracted and air ingress minimised.

Additional benefits of a well-designed, constructed and maintained cap are that release of odours is minimised, slope stability is increased and the landfill (after vegetation of the cap) should have less of a visual impact to the local surroundings.

Good planning of the tipping sequence and management of the tipping area help optimise the potential for LFG generation and control.

Waste Placement and Tipping Sequencing

If you have a clear and planned tipping sequence for waste deposits, and if you actively manage the tipping area, then you can manage how the landfill is being operated much more effectively and, in turn, maximise LFG potential. The area into which waste is tipped on a particular day is commonly referred to as the 'tipping face'; whereas the height of waste tipped and compacted to form a specific layer is known as a 'lift'.

Restricting tipping operations to a small but manageable area makes it easier to compact and cover waste deposits – the benefits of these management techniques for LFG potential are summarised later in this chapter. Using bulldozers to form the face of the waste lifts into gentle slopes (directed towards storm water drainage systems) also helps to minimise rainwater ingress into the waste mass, reducing leachate formation and the potential for elevated leachate levels to disrupt the LFG collection network.

Additional benefits of a properly planned and managed tipping area and schedule are that the waste can be covered quickly and efficiently (reducing the potential for litter to be blown or pests to infest the waste) and that visual impacts and the impacts of odours on local communities are minimised.

Compaction of Wastes

Ideally, waste compaction should be carried out as waste is delivered to a landfill tipping area, but, as a minimum, it should be completed at the end of each working day/shift. Compaction is significant for a number of reasons and generally requires the use of appropriate heavy equipment (HE). The benefits of waste compaction are as follows:

Both covering and compaction of tipped waste not only improve the potential for LFG production but also improve environmental and health protection and reduce the possibility of fires.

- a higher volume of waste can be accommodated per site/cell, increasing landfill life;
- increased waste density reduces waste permeability and leachate generation;
- the potential for differential settlement is decreased, reducing damage to site infrastructure built on closed cells (haul roads, LFG extraction pipes etc.);
- increased slope stability;
- compacted waste is easier for waste trucks and other vehicles to manoeuvre over;
- compacted waste is less likely to give rise to the release of litter and/or odours;
- cover material requirements are reduced; and
- the potential for waste fires is lessened.

Covering of Waste

Daily cover is applied progressively throughout the day (or at the end of the working day), while intermediate cover is applied when an area of waste is being worked on for an extended period of time. Cover thickness ranges from a thin layer, from a few mm up to 15 cm. Inert soil is the most common form of cover material but shredded green waste/ compost residues or even tarpaulins can be used. The benefits of daily and intermediate cover for LFG WtE include:

- the cover isolates the waste from the wider environment, which can improve anaerobic landfill conditions and, therefore, the production of LFG;
- the application of cover reduces the amount of LFG that can freely vent to the atmosphere; and
- less permeable soil cover (e.g. clayey materials) can be used; if such materials are used as a daily cover, however, they should be removed the following day to avoid parched leachate layers and blocked/restricted gas flow.

The additional benefits to be gained from effectively covering waste are similar in nature to the benefits of effective waste compaction, including: minimising windblown waste, flies, vermin and odour, improved surface runoff, decreased leachate production, reduced potential for landfill fires.

Slopes

The main controlling impact that slopes have on LFG potential is the possible damage to LFG collection infrastructure caused by a slope failure or the disruption caused to a LFG collection area/functionality as an indirect result of slope failure (loss of soil cover and resulting erosion), leading to leachate/LFG releases and air/water ingress – both of which unbalance the LFG generation and extraction environment. A guide to typical slope angles is given in Figure 2.6 below.

Landfill Fires

Landfill surface and/or sub-surface fires are indicative of bad landfill management and are bad for WtE power projects as they use up the fuel (waste/gas) required to generate power and can damage infrastructure. Surface fires (possibly caused by the dumping of smouldering waste at the landfill or the lighting of fires by scavengers) are generally easier to extinguish than sub-surface fires (possibly started by a chemical reaction, heat or air being drawn into the waste mass), which require the removal of one or more of the three key elements required for fire – oxygen, fuel or heat. Monitoring waste tipping operations (checking for combustible loads), providing fire-fighting equipment (to quickly extinguish any fires encountered) and constantly observing the landfill for any signs of sub-surface fires are all good management practices to prevent and control landfill fires and thereby minimise their associated negative impacts.

Apart from being bad for the environment and the health of those living or working nearby, landfill fires consume the fuel and gas intended for power generation. Monitoring of tipping operations and landfill conditions, as well as provision of fire fighting equipment, are essential.

Additional factors that can be negatively impacted by landfill fires are, of course, the environment, as well as the health of the local population and the staff working at the landfill.

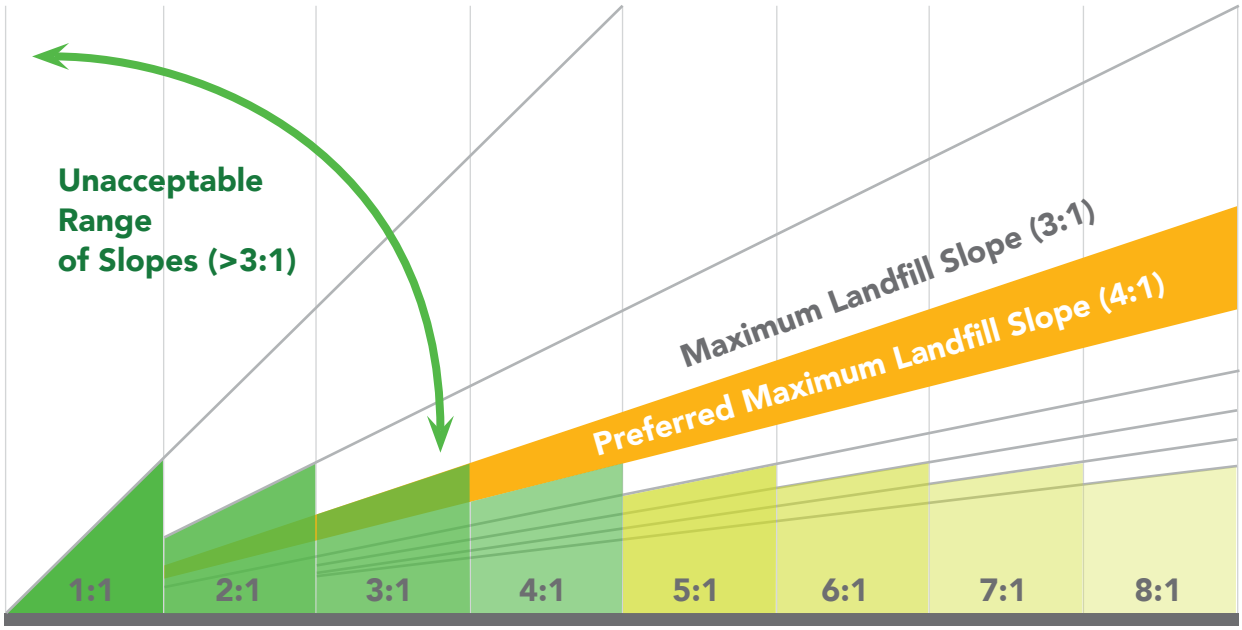


Figure 2.6: Recommended landfill slope guide (Global Methane Initiative 2012)

2.6 INTEGRATED WASTE MANAGEMENT - THE INTERACTION BETWEEN WASTE COLLECTION, HANDLING AND LANDFILL PROCESSES, AND OTHER WTE PROJECTS

In this and the previous chapter we looked at how landfills are designed and operated in Indonesia and how they could be better constructed and managed to increase their LFG potential. It is without doubt that, if you have a well-designed, constructed and managed landfill, LFG utilisation/management will at least make your landfill a better site, and it may even produce revenue to help you cover the costs of running/maintaining the landfill.

Figure 2.7 Can be used as a useful checklist of all the issues to be considered when planning a SWM process.

Figure 2.7 shows how the different elements of solid waste management and WtE projects sit within the Integrated Sustainable Waste Management System (ISWM). The model is a detailed one and we are not able to cover all the variables in this guidebook. Nevertheless, we set out below some examples of the interactions/issues you should consider and the trade-offs that you will need to evaluate to optimise your SWM planning.

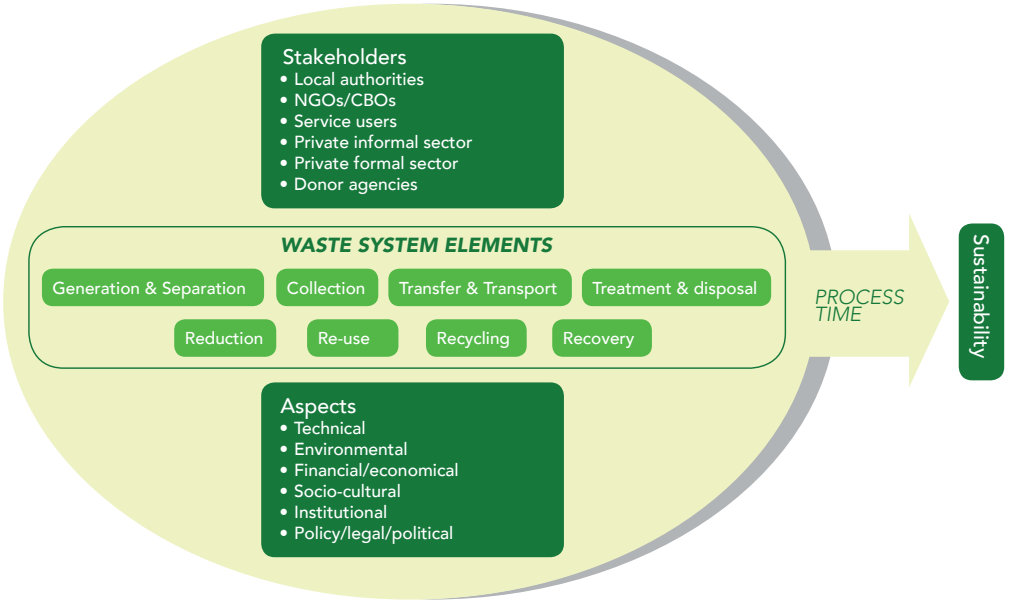


Figure 2.7: The integrated sustainable waste management (ISWM) model

A detailed feasibility study is required to establish the optimum SWM methods and technology on a case by case basis.

To create a truly valid and sustainable SWM plan you will need to conduct a detailed feasibility study, model the costs and benefits of the various SWM scenarios and consider all the technical options available to you. Once you have all this information, you can decide on the best system that you can afford to construct/maintain and that will meet your needs now and in the future. In conducting your research and making your decisions, you should make sure you consider what is available in the marketplace. It is vital, however, that you question objectively every supplier who offers to solve all your problems for you; technology suppliers cannot understand all the details of your SWM environment fully (only you can do that), so they may not be able to offer solutions that really meet your actual needs.

2.7 INTERACTIONS AND POTENTIAL CONFLICTS BETWEEN DIFFERENT ELEMENTS OF INTEGRATED SOLID WASTE MANAGEMENT

The following sub-sections are designed to show how different elements of the SWM system interact with one another, to identify potential problems and to support you in finding solutions that work for you.

Waste Segregation/Collection

Waste segregation at source is an effective way of keeping individual types of waste apart with the aim of optimising their economic value (recyclables are normally worth more when 'clean'). However, segregation at source is still limited in Indonesia as it requires 'community buy-in' and effective household level collection.

Whilst segregation at source reduces the cost of transporting bulk waste to landfill, these savings must be weighed against the economic impact it has on downstream SWM activities.

Segregation at source will be a key consideration, if the fundamental focus of your SWM system is to maximise recycling/reuse and minimise waste to landfill. In theory, you could segregate all plastics, metals, glass, paper, card, organics etc. and create products from waste (compost, plastic bags/bins etc.) or just sell the materials in the marketplace.

Diversion of organic waste to composting reduces landfill inputs and potentially extends the life of the landfill, but it decreases the LFG production potential (if landfilling is your primary waste treatment/disposal method) and will lower the viability of thermal treatment options by reducing the calorific value of input wastes.

Thermal treatment, using pyrolysis or incineration (mass-burn), does not require waste sorting/segregation, although the calorific value of waste inputs could be increased by the removal of glass, metal, stone etc. (non-combustibles). Segregating, or removing, combustible waste, directing it away from an incineration plant will, however, reduce the calorific value of the waste combusted and, therefore, the profitability/viability of the incinerator. For refuse derived fuel (RDF), segregation at source is useful in isolating the paper/plastic/organic wastes that will provide a more suitable basis for RDF feedstock production, but that waste will still need to be treated (to reduce moisture content) before it can be converted to RDF. In that case, therefore, segregation may be more efficiently carried out centrally (TPST), rather than at source.

To choose the right option you will need to compare the costs of waste segregation at source (and subsequent collection) against the positive, or negative, economic impacts it has on your downstream SWM activities.

Centralised/Integrated Treatment Facility

Centralised/integrated waste treatment facilities (ITFs) can take many forms but they often have a common element, i.e. a material recovery facility or MRF. A primary function of MRFs is to take general mixed waste (normally MSW) and separate it into recyclable components and residues, essentially fulfilling the same purpose as segregation at source. This is much easier to implement in Indonesia than segregation at source and more cost effective than in Europe due to lower labour costs.

MRF/ITF options are likely to have a positive impact on the lifespan of a landfill (by diverting waste from the landfill) but they will reduce the potential to run an LFG power project because they divert organic waste away from the landfill.

If the MRF/ITF is going to supply an RDF plant, then removal of moisture from the waste will be essential. RDF typically requires a moisture content of <20% (MSW waste in Indonesia has a moisture content of ~ 45%). The removal of moisture will increase the calorific value of RDF, as will the shredding of wastes into a more uniform size/shape. An evaluation will be required to decide whether the extra cost of waste pre-treatment to produce RDF is outweighed by the additional financial benefits gained when compared to mass-burn or landfill.

RDF/Incineration

If RDF/incineration options are the primary focus of an SWM system, then the related impacts to landfill will be fairly significant. While RDF/incineration will significantly reduce the amount of waste going to landfill, incinerator ash and other waste residues will still require landfilling. The landfill will not need to be as big, will last longer and will likely need less sophisticated infrastructure, such as LTP (leachate treatment plant), due to the restricted range of waste inputs and the reduced volume of deposits.

On the reverse side, the principal negative impact will be that the LFG potential of a landfill will be greatly reduced or eliminated. Again, a proper assessment of a potential SWM system will need to be undertaken in order to establish which option (landfill/thermal treatment) is most credible and obtainable.

2.8 FEEDSTOCK AGREEMENTS FOR WTE PROJECTS

Secure and suitable supplies of feedstock are vital for the success of a WtE project and must be addressed in the feedstock agreement between the operator and the GCA.

The feedstock plays a vital role in any WtE project, since it acts as the 'fuel' required for power generation. Continuity of an adequate and suitable supply is therefore critical for the operation of WtE plants and their ability to maintain a stable power output/supply. In order to maintain and guarantee the supply of MSW to the WtE plant, the private sector plant operator and the GCA must have a feedstock agreement (FA) in place as part of the PPP agreement (see section 8 of chapter 2).

The FA contains several important points that need to be agreed between the parties, including the following:

- Quantity of waste - the agreed minimum and maximum amount of waste to be supplied clearly stated on a tonnes per day basis. This is crucial because it is related to the tipping fee to be received by the operator and therefore has a major impact on financial planning and management. In relation to the conditions covering the agreed quantity of waste to be supplied, the FA should also stipulate how the waste will be weighed, including the potential involvement of an independent third party to quantify the amount.
- Type of waste - in Indonesia, only household waste (or waste similar/equivalent to household waste) is allowed to be disposed of in a landfill.
- Penalties - the FA should set out the sanctions to be applied, if the feedstock supply is not in line with the agreement.
- Landfill operation - the FA should include agreed operational procedures for the landfill to ensure that LFG potential is maximised and that any potential detrimental impacts on the environment/local community are minimised.

It is important to note that the GCA may delegate waste management collection and transportation to a City Sanitation Department/Dinas Kebersihan, or other legal entity under a legal decree.

2.9 THE ENVIRONMENTAL REQUIREMENTS FOR LANDFILL

By their very nature landfills pose serious environmental health and safety (EHS) risks, which require careful consideration in the design, planning and operation of the landfill facilities. Landfill waste produces greenhouse gases and leachate as it breaks down; if fires occur, toxic emissions are released; windblown waste, rodents and insects can all cause public health and disease issues. As a result, landfill disposal sites need to be supervised and managed, both those still in operation and those that have been closed.

Landfills are potential sources of disease, toxins and pollution and must be carefully designed and managed to minimise these risks.

Whilst EHS at landfills is not specifically covered under Indonesian legislation, the requirements for safe working and living environments are mentioned under the Waste Management Law UU18, 2008, and Ministry of Public Works regulation 03/2013, which covers landfill infrastructure and utilities, provides detailed guidelines for the development of sanitary landfills.

A sanitary landfill is a carefully engineered, structurally stable formation of lined waste cells separated by soil cover material, with base and side slopes designed to minimise infiltration and facilitate the collection of leachate. Landfills are sited, designed and operated to isolate the waste from the surrounding environment, particularly soil and groundwater. Even after closure, landfills require long-term care to ensure that the waste remains isolated, including maintenance of the capping system: collection and treatment of leachate; collection and flaring, or utilisation of landfill gas; and monitoring of groundwater (International Finance Cooperation, 2007).

The risks from landfill must continue to be managed after the facility has been closed down.

According to Indonesian National Standards, the selection of a site for a landfill should meet the following key requirements to ensure sound environmental and technical standards:

- the site should not be within a seismically active area prone to earthquake, landslides, floods etc.;
- the site should not be in a hydrogeologically vulnerable area or where the ground water depth is less than three metres; and it should not be built close to a ground water resource;
- the slope of the landfill should not exceed 20%;
- the site should not be located near an airport (minimum distance is 1.5 - 3 km);
- the site should not be near any residential areas (not closer than 1 km from the perimeter of the landfill); and
- the site should not be in a protected zone, such as a protected forest.

A World Bank survey (Urban Papers UP-2, 2006) highlighted main EHS issues associated with landfills, which should be considered by operating authorities. These include:

The World Bank has listed the key safety, health and environmental risks from landfill facilities.

- back and joint injuries sustained from lifting heavy waste-filled containers and driving heavy landfill and loading equipment;
- respiratory illness from ingesting particulates, bio-aerosols and volatile organics during waste collection, and from working in smoky and dusty conditions at open dumps;
- infections resulting from direct contact with contaminated material, dog and rodent bites or eating animals fed on waste;
- puncture wounds leading to tetanus, hepatitis and HIV infection;
- injuries at dumps due to surface subsidence, underground fires and slides;
- headaches and nausea from anoxic conditions at disposal sites with high methane, carbon dioxide and carbon monoxide concentrations;

- lead poisoning from burning of lead-containing materials, such as batteries, paints and solders;
- contaminated leachate and surface runoff from land disposal facilities, which affect down gradient ground and surface water quality;
- emissions of methane and carbon dioxide from land disposal facilities, which contribute towards global warming and, subsequently, to vector-borne diseases and pathogens;
- emissions to air of volatile organic compounds , with associated inconclusive evidence of altered cancer incidence, birth defects and infant mortality, as well as psychological stress for those living near solid waste incinerators or inadequately controlled land disposal facilities;
- animals feeding on solid waste, providing a food chain path for transmission of animal and human diseases;
- uncollected waste retaining water and clogging drains, leading to stagnant water, which encourages mosquito vector abundance; and
- uncollected waste providing food and breeding sites for insects, birds and rodent disease vectors.

2.10 POTENTIAL SAFETY HAZARDS ASSOCIATED WITH LANDFILLS

At the moment the vast majority of landfills in Indonesia are not controlled and constitute a real threat to health and safety.

At present, about 90% of waste disposal facilities in Indonesia are not classified as controlled or sanitary landfills. As a consequence, the potential for accidents at these facilities remains high. The main threats and hazards to human health and safety associated with landfills in Indonesia are set out below.

Landfill Slope Stability

We look briefly here at these threats: slope stability…

A landfill as a site for dumping and management of waste is vulnerable to waste landslides, if the waste slopes are not maintained within controlled minimum factors of safety and leachate levels. Typically, a safe slope angle is 3:1 (three horizontal to one vertical). Moisture content, compaction, waste type and other factors affect and reduce the factor of safety (FS). If the FS is below 1, slope failure may occur. This typically happens along an internal rotational shear plane, as shown in figure 2.8 below.

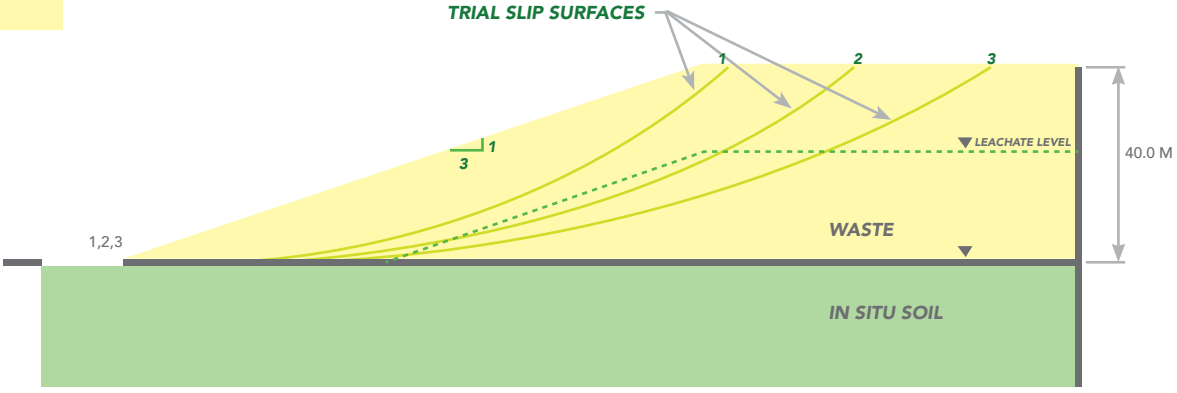


***Figure 2.8**: Landfill slope angles and shear planes*

Landfills settle over time and slope angles reduce, with the result that the slopes become more stable.

Similarly, hydrological (rain) factors also affect the stability of the landfill. If waste becomes saturated, stability will reduce. It is therefore important to use intermediate cover and final capping with drainage control to divert rainfall away from the waste cells. Landfill cell stability also relies on the underlying soils and natural slope. If the soils are too soft or waterlogged, they settle, thereby affecting landfill stability. If the underlying slope is too steep, failure can occur along similar mechanisms described above.

Accidents Related to Heavy Equipment

…industrial accidents…

In Indonesia, some of the most common accidents at landfills involve heavy equipment such as trucks, bulldozers, excavators and compactors, all of which are required to operate a modern landfill. Scavengers collecting waste on the landfill will always concentrate on freshly deposited waste as this contains the highest levels of recyclables. Unfortunately the fresh waste is also the waste which must be worked by the heavy equipment. What commonly happens is that scavengers are injured by being hit by heavy equipment or while struggling to collect valuable waste from trucks as they are unloading. The activities of the scavengers in landfills seriously interrupt the operation of heavy equipment and trucks moving waste to specific cells or sites. Unfortunately, it is common at many landfills in Indonesia for scavengers to work on the active landfill cell tipping zone. A safe alternative option would be for waste to be deposited at a sorting station or MRF to be worked on by the scavengers before being transported to the landfill for final disposal.

Gas Explosions

… explosions …

Waste also contains significant amounts of flammable gas (methane) that can start fires and is harmful for the environment, utilities and workers. The potential for gas explosion is determined by the lower explosive limit (LEL) and the upper explosive limit (UEL). Methane gas in landfills can explode between 5 % LEL and 15 % UEL of air volume. Landfill authorities therefore need to provide portable gas detectors, and ensure enclosed working areas are well ventilated.

Toxic Gas

…and the release of toxic gases.

Landfill waste contains toxins that are harmful to humans and the environment and could cause illness when they enter the body through inhalation or via the skin or the mouth. The toxic gases resulting from waste decomposition include NOx (nitrate, nitrite), SOx (sulphate, sulphite), NH_3 (ammonia), and Cl_2 (chlorine). Toxic gases, dioxins, are also released if the waste is burnt.

2.11 REQUIRED EHS TRAINING FOR THOSE OPERATING, OR WORKING IN, LANDFILLS

Table 2.3 below sets out the basic training required for those operating or working in landfills in order to ensure that the landfill complies with the relevant regulations and has minimum impact on environmental health and safety.

In this table we take a comprehensive look at the health and safety training required to ensure safe operation of landfill facilities.

EHS training and objectives and content

Introduction to environmental health and safety

Purpose:
To inform about potential general HSE risks and hazards associated with waste management, especially on landfills, and preventive action plans to reduce or eliminate the number of incidents and accidents on site.

Content:
- potential HSE risks and impacts during the waste cycle (transporting, processing, disposal);
- benefits of good HSE practice for employees, the operating company and the surrounding environment;
- HSE policy and applicable HSE standards and regulations for landfill construction, operation and maintenance;
- HSE team organisation chart showing roles and responsibilities;
- basic (safety induction) and specific HSE training for visitors, operators, the maintenance team and contractors;
- safety meeting schedule and programme;
- HSE monitoring programme;
- emergency response plan and communication system.

Safety and health, environment regulations and standards

Purpose:
To provide basic understanding of regulations and standards related to waste management, especially during landfill construction and operational phases.

Content:
- internal HSE policy, targets and written procedures;
- compliance with national and international regulations for waste management;
- national and international regulations covering the potential environmental impacts of waste management;
- standard operator training (SOPS) available for waste management during construction, transport, landfill operation and maintenance;
- systems to control HSE implementation and regulations, including rewards and sanctions;
- work permit systems (if required) to manage high risk works, such as equipment/facility shutdown.

Introduction to health and safety for landfill construction

Purpose:
To inform all operators, visitors, contractors and design engineers of the potential HSE risks during the construction phase.

Introduction to health and safety for landfill construction

Content:

- potential risks (slip, falls, heavy equipment incidents, electric shock and fire) from construction work, especially from truck loading and unloading, construction equipment and materials, use of mechanical and electrical devices, excavating, piling, working at height etc.;
- HSE regulations and standards applicable to construction activities;
- general lay out and security plan (including buffer zone along the site perimeter, access from single control point;
- programme to minimise or eliminate the risks associated with construction work;
- management visualisation board to maintain daily safety programme;
- counter-measures against third party entrance (worker identity card control);
- proper use of fencing and security guards;
- appropriate safety signage, hazard warning boards and lightning protection;
- provision of designated off-site smoking areas for employees.

Heavy equipment and excavation hazards

Purpose:
To provide information about potential hazards and risks from heavy equipment and excavation works.

Content:

- requirements (training and competency) for heavy equipment and excavator operators;
- typical types of heavy equipment used and their roles;
- SOPS for using and maintain equipment properly;
- clear and written roles and responsibilities of operators, signal men and supervisors during excavation works;
- protection system plans, such as installing soft/hard barricades, safety lines and warning signs on heavy equipment and working areas;
- check sheet components and inspection schedules.

Landfill emergency response planning, including disaster risk reduction and management

Purpose:
To provide training on potential emergency conditions on site, preventative measures and procedures to manage risks.

Content:

- definition and classification of emergencies (low-, medium- and high-risk);
- potential risks and injuries to employees, the community and the surrounding environment;
- operational controls and risk reduction measures, including SOPS for handling high-risk waste (mixed), such as infectious, toxic and hazardous waste, covered fire and explosion hazards, accidental spills of vehicle fuel, contaminated run off or gas release;
- safety and traffic signs for operational vehicles and heavy equipment;
- assigned emergency team response and roles (fire, medical/first aid, accidents, spills of fuel or hazardous materials, gas release, security etc.), accompanied by suitable training;
- emergency alert and alarm systems and procedures;
- hazard communication lines;
- emergency management plan (hospital, fire brigade maps, phone numbers etc.);
- evacuation routes, procedures and designated assembly points;
- maps of site locations for fire extinguishers, gas and odour detectors;

- check sheet for monitoring the operation of emergency response devices, such as fire extinguishers and hydrants;
- simulation programme and measurable results to check the effectiveness of the emergency response plan;
- procedure to register waste pickers on the landfill and HSE induction training for them.

Incident and accident investigations

Purpose:
To provide clear information and countermeasures in the event of an incident or accident occurring in the workplace.

Content:
- programme to identify risks and hazards from typical incidents and accidents;
- procedures to respond to incidents and accidents;
- procedures to monitor and review effectiveness of the incident and accident plan;
- the incident and accident notification/communication flow;
- the report format and procedures for reporting of incidents and accidents (including specific countermeasures and preventative plans) and a programme to identify typical hazards;
- rehabilitation and return to work procedures.

Personal Protective Equipment (PPE) at solid waste landfills

Purpose:
To provide information about the types of PPE required, specifications, benefits and use.

Content:
- benefits of PPE use (for type of PPE) in eliminating or reducing risk;
- the consequences and sanctions of not using PPE;
- identification of PPE associated with specific work activities (construction work, hot work, working at height, excavation work etc.);
- procedures for recording PPE stock and availability;
- procedures for using and maintaining PPE properly;
- procedures for proposing PPE replacement;
- procedures for checking PPE usage.

Landfill gas protection and methane management, including odour gas response

Purpose:
To cover landfill gas and odour management in order to minimise or eliminate HSE risks, especially fire and explosion hazards by installing gas detector systems and other related protection systems.

Content:
- general description of gas and odour management systems (process flow and facilities);
- description of possible events that could lead to gas and odour leakage;
- leaked gas and odour detector system and protection action plans;
- procedures for identifying and inspecting equipment failures;
- procedure for gas, odour and critical equipment shutdown during abnormal conditions;
- prior informed consent (PIC) procedures for equipment shutdown and associated training to ensure safe operation;
- odour gas response procedures, such as odour-neutralising sprays (where necessary);
- specific training for lock out and tag out (LOTO) for gas valve management operators and maintenance teams (if required).

Safe transport
Purpose: To cover the safe transportation of waste material to and from, and within, landfills operations. **Content:** ▪ maximum driving speed during waste transport; ▪ safe procedure during loading and unloading activity; ▪ risks associated with increased road traffic intensity due to waste transportation to and from the waste facility; ▪ designated safe area for turning and manoeuvring; ▪ protection plan to control oil/fuel spills/leakages during transport in order to prevent runoff water and water from wheel washing contaminating ground water and soil.

***Table 2.3**: EHS training programme for landfill operators and staff*

Chapter Checklist	✔
Now that you have read this chapter:	
Do your MSW handling and landfill management techniques comply with Indonesian legislation?	
Do you understand how MSW handling and landfill management impact on WtE?	
Are your MSW handling and landfill management techniques providing enough feedstock of the right quality for the WtE process?	
Are you aware of the environmental health and safety hazards posed by landfill operations?	
Are you familiar with the environmental health and safety regulations governing landfills?	
Have you got the correct environmental health and safety measures in place, including any staff and operator training required?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 3

AVAILABILITY OF FEEDSTOCK

WHAT THIS CHAPTER IS ABOUT

In this chapter we examine the supply of waste to energy (WtE) feedstock in Indonesia, its composition and characteristics and how it can be utilised by different WtE technologies.

We look at the key factors affecting the technical and economic viability of feedstock, including availability and reliability of supply, composition and density.

We consider the supporting infrastructure required to collect, store, process, treat and transport the feedstock.

We end the chapter by looking at the various types of biogas systems that can be used with WtE projects.

THE KEY POINTS

3.1 WASTE COMPOSITION

Indonesia produces sufficient quantities of municipal waste with the right characteristics to power WtE projects all over the country.

The composition and properties of the waste have an impact on the energy efficiency and operation of the WtE facilities and their emissions. The operation of waste to energy (WtE) power plants is dependent on the quality and availability of the 'feedstock', the municipal solid waste, which can be used as fuel for the WtE plant. Indonesia produces vast quantities of municipal waste suitable for conversion to energy. According to Ministry of Environment figures, the volume of solid waste produced by the country increased sharply in the period 2010 – 2012; it was 200,000 tonnes a day in 2010 and more than doubled to 490,000 tonnes a day in 2012.

The composition of Indonesia's municipal waste means that segregation and sorting are required to arrive at the correct type of WtE feedstock.

Segregation and sorting of the waste are required for most WtE feedstock material in-order to select the optimum feedstock components. Waste segregation at source is the preferred and most efficient method. However, this requires community/producer buy-in and robust government collection systems, neither of which is common in Indonesia at the moment. For this reason, the most commonly available segregation method is a sorting station or material recovery facility (MRF), which can be co-located with the WtE plant or at an intermediate/ transfer station.

The general composition of waste in Indonesia is:

- 55 - 70% organic (biodegradable/perishable)
- 30 - 45% inorganic (non-biodegradable/non-perishable); and
- less than 1% toxic/hazardous waste (B3).

Inorganic waste can be subdivided into: paper, plastic, wood, fabrics/textiles, rubber/ artificial leather, metal, glass, metal and glass, dismantled waste, toxic/hazardous waste (B3) and other (stone, sand, disposable nappies, polystyrene).

Nearly half of Indonesia's waste is produced by the residential sector.

According to waste statistics data collected by the Ministry of Environment, plastic waste is the second highest waste generated by volume with approximately 5.4 million tonnes per year, equivalent to 14 % of the total. Municipal waste is generated from housing, supermarkets and traditional markets, schools, offices, shops, restaurants, hotels, streets, parks, railway stations and bus terminals. The dominant waste generated in Indonesia is from the household sector (48 %), traditional markets (24 %) and commercial areas (9 %), while the rest comes from public facilities (schools, offices, roads etc.).

A recent study of the composition and characteristics of urban waste in Jakarta found that most waste is produced from residential areas and offices, 60 % and 25 % respectively. The results of the survey are summarised in figure 3.1 below.

No	Source	%
1	Residential areas	60.50
2	Modern markets	0.06
3	Traditional markets	0.07
4	School	0.20
5	Offices	25.19
6	Shops	1.89
7	Restaurants	1.11
8	Hotels	0.38
9	Streets	10.04
10	Parks	0.55
11	Railway stations	0.00
12	Bus terminals	0.01
		100

***Source**: Study on Waste Composition and Characteristics in DKI Jakarta, 2011*

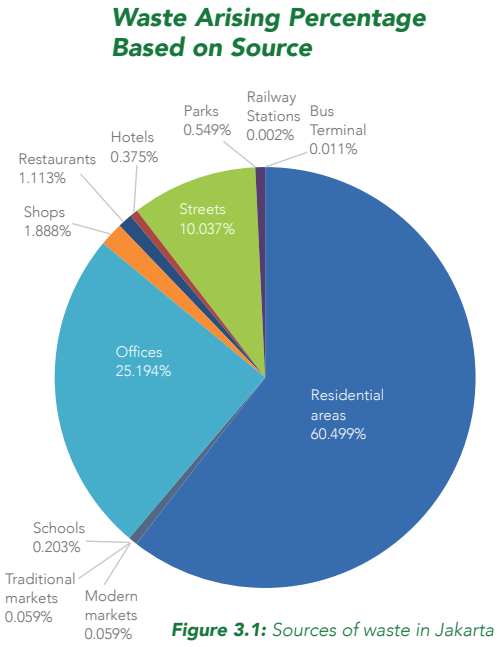


***Figure 3.1:** Sources of waste in Jakarta*

Waste can be further categorised as being generated in either urban or rural environments. Urban waste tends to have higher inorganic content, whereas rural waste will have a higher organic fraction.

Rural waste is high in organics, while urban waste is high in inorganic material, including large amounts of plastics.

Economic and urban developments in Indonesia and big cities like Jakarta have resulted in the production of large amounts of plastic and paper waste, including food packaging, nappies and cardboard. The most common plastic items are food and drink packaging and plastic bags.

The Environmental Agency of Jakarta also reported that plastic waste accounted for more than 6,000 tonnes per day, or 13 % of the total waste generated. However, organic waste is still the dominant waste produced in Jakarta. The diagram below shows the composition of Jakarta's waste.

However, organic waste remains the dominant component of jakarta's waste.

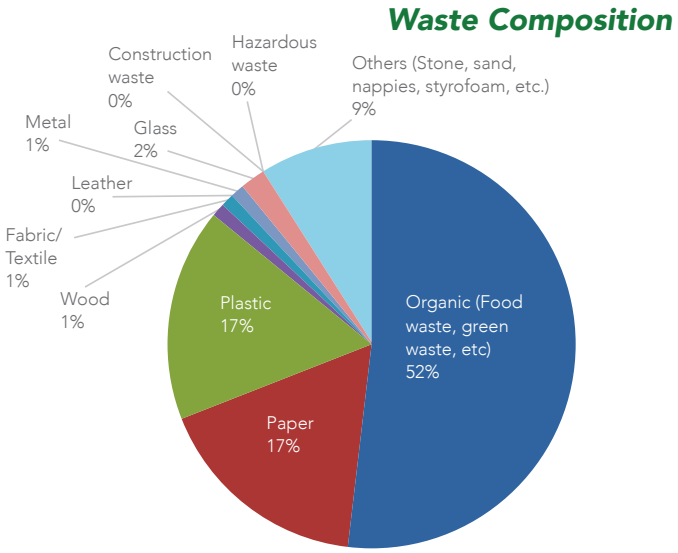


***Figure 3.2:** The composition of Jakarta's waste*

3.2 WASTE REDUCTION

The Indonesian Waste Management Law No. 18 of 2008 promotes waste reduction through the 3Rs (Reduce, Reuse and Recycle). It is estimated that between 10 – 20 % of waste produced in Indonesia is currently recycled through communities and private sector activities. The number of waste banks rose from 471 in February 2012 to 1,195 by December 2012, distributed across 55 regencies/cities. During period 2010 – 2014, the Ministry of Public Works built more than 336 3R facilities across the country.

If the waste being considered as feedstock for a WtE project is being segregated, potential investors must carefully consider whether the fuel stream post segration is going to aid or hinder power production.

The advantages of waste segregation are that it recovers recyclables, creating valuable income and boosting livelihoods, reduces waste volume and environmental impact and extends the life of landfills. However, waste segregation can have either a positive or negative impact on a WtE project, depending on whether the components being recovered are beneficial or detrimental to the feedstock. This is a key consideration for WtE project stakeholders.

3.3 WASTE CHARACTERISTICS

Waste is characterised by its ash content, moisture content and its chemical constituents, including carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorous. The constituent components are quantified in terms of: calorific value in kcal/kg, water content and ash content by percentage weight, volatile content by percentage and the carbon/nitrogen ratio.

The characteristics of the waste determine:
- *the energy input needed to process the waste into useable feedstock (through collection, separation, densification, dewatering, shredding);*
- *its compatibility with conversion technologies;*
- *air and greenhouse gas life cycle emissions; and*
- *net energy output.*

The characteristics of the waste are an important consideration when selecting WtE technology. WtE technology can be broadly split into two categories, each requiring different characteristics from the feedstock, as summarised in the table below.

Process	Technology	Required Feedstock Characteristics
Biological	Landfill gas (LFG) and anaerobic digestion (AD)	**High organic content** (food, vegetable, market waste, garden/ green waste). Moisture content not critical, pH sensitive. No rubble, metal or glass.
Thermal	Refuse-derived fuel (RDF), mass burn (incinerator), pyrolysis, plasma arc, etc.	**High calorific value** (paper/card, plastics, wood, fabric/textiles, rubber etc.). Low moisture content critical. No rubble, metal or glass.

Table 3.1: *WtE technology feedstock characteristics*

3.4 WASTE PROCESSING FOR FEEDSTOCK

With the exception of those using LFG, the majority of WtE technologies require some form of processing of the waste stream to maximise the performance and power potential from the feedstock. For this reason most WtE plants are co-located with a sorting station or MRF. Waste is sorted to remove the non-beneficial components from the final feedstock. In the case of AD plants, inorganic materials are removed. For thermal process plants, wet waste and low calorific value waste is removed. In both instances inorganic, non-combustible waste, such as rubble, metal and glass is taken out.

Sorting stations/MRFs in Indonesia typically consist of an open platform or series of bays, where waste is deposited by truck and waste pickers manually sort the waste. An alternative mechanised system preferred for its convenience, but with higher Operation and Maintenance (O&M) costs, is the conveyor sorter system, where waste from the truck is dumped into a hopper which feeds a conveyor belt passing a line of waste pickers; the rejected waste passes off the end of the conveyor into a waiting truck or roll-arm container for transport to the landfill or final disposal site (TPA).

Whether the WtE power generating process is thermal or biological, removal of inorganic, non-combustible waste is required.

Figure 3.3: *Sorting station platform at Gampong Jawa, Aceh*

Figure 3.4: *The conveyor sorter at Sarbagita, Bali*

Whilst the biological WtE process requires the removal of inorganic content from the feedstock, many of the materials removed can generate further income for the operation as recyclables.

The potential to utilise waste in WtE plants is influenced by the density of the waste, its moisture and ash content, its heating value and particle size distribution. Thermal WtE technology feedstock is dependent on its chemical content (carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorous) and its volatile content. Typically, waste with a calorific value greater than 1,400 kcal/kg is suitable for thermal WtE feedstock. On average, 0.45 kg of municipal solid waste has the potential to produce an average heating value of 5,100 BTUs. However, this is dependent on the form of the waste and level of processing required.

Biological WtE processes rely on high organic waste content, which decomposes due to the action of microorganisms, producing methane gas, which is used as the fuel for power generation. The biological process is more effective, if inorganic waste content is removed at the sorting station or MRF. As most inorganic content (plastic, metal, glass) has a recovered value as recyclables there is the added bonus that further income can be generated whilst processing the feedstock.

Once the waste has been sorted further processing of the feedstock may be required to improve its quality before delivery to the WtE plant. For biological processes, such as AD plants, very little is required beyond maybe shredding the waste to increase its surface area. For thermal process plants it is important to dry the feedstock. It can also be shredded for added efficiency. The production of RDF requires that the waste is dried, then either shredded to produce a 'fluff' or pelletized.

Figure 3.5: *RDF fluff*

Figure 3.6: *RDF pellets*

3.5 BIOGAS GAS SYSTEMS FOR ENERGY

Household bio-digesters are common in Indonesia, especially in remote, off-grid areas, where they provide gas for cooking and lighting.

The production of biogas from organic waste, such as market waste, garden waste, food scraps, animal manure and food industry waste provides inexpensive, renewable and environmentally friendly energy.

Biogas is a renewable gaseous fuel produced by anaerobic digestion or anaerobic fermentation of organic matter by the action of Methanobacterium sp. Bacteria. This process produces gases, mainly methane and carbon dioxide, with hydrogen sulphide, nitrogen, hydrogen and oxygen in lesser amounts.

Organic waste feedstock is fed into a closed chamber where the anaerobic environment encourages breakdown of the waste by bacteria and the production of methane, which is piped off and used for power production. The by-product, liquid sludge produced by the process is a high-quality fertiliser that can be used in agriculture, parks and gardens.
There are numerous examples of small-scale (household) bio-digesters in Indonesia, which rely on household waste, garden waste and livestock manure for feedstock. These are particularly common in remote, off-grid areas, where the bio-digester is used to provide gas for cooking and lighting.

Household bio-digesters are common in Indonesia, especially in remote, off-grid areas, where they provide gas for cooking and lighting.

Commercial-scale plants are still rare but there are many in the planning stage. The high organic content and high moisture content of waste in Indonesia favours the selection of AD as a suitable WtE technology. In addition, bio-digesters can take organic waste from a variety of sources and at the commercial scale a municipal solid waste (MSW) feedstock can be mixed with sewerage sludge very effectively, helping local governments to deal with two waste sources simultaneously.

Commercial-scale bio-digesters are still rare in Indonesia but several are being planned.

Figure 3.7: *A small-scale home bio-digester*

Figure 3.8: *A commercial-scale bio-digester*

Chapter Checklist	✔
Now that you have read this chapter:	
Do you know what types of waste are suitable as feedstock material into WtE plants?	
Do you know if your landfill contains the right types and compositions of waste for WtE power production?	
Do you know what systems and technologies you need to introduce in order to produce optimum quantities and quality of feedstsock?	
Would a commercial-scale bio-digester help you with your waste management?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 4

LANDFILL GAS HARVESTING AND PRODUCTION SYSTEMS

WHAT THIS CHAPTER IS ABOUT

In this chapter we examine the conditions required to generate landfill gas (LFG) in waste.

We look at the technology and systems needed to capture, transport and treat the gas safely.

We provide practical guidelines for local governments across Indonesia to help them decide whether they have the right resources, knowledge and expertise to operate or commission a successful LFG project.

We examine the generator technology required to produce the electrical output of the waste to energy (WtE) plant.

THE KEY POINTS

- The conditions required to generate landfill gas from waste. *page 58*
- How gas is captured and transported to the power plant. *page 61*
- The most suitable capture, transportation, processing and generating technologies for Indonesia. *page 66*
- The treatments and processing required before the gas can be used. *page 70*
- How to estimate and model the amount of gas a landfill can generate. *page 74*
- The generator technologies for producing electricity from the gas. *page 75*

4.1 GAS PRODUCTION

Methane gas is an aggressive greenhouse gas; burning it through a flare or generator reduces GHG impact by a factor of 25.

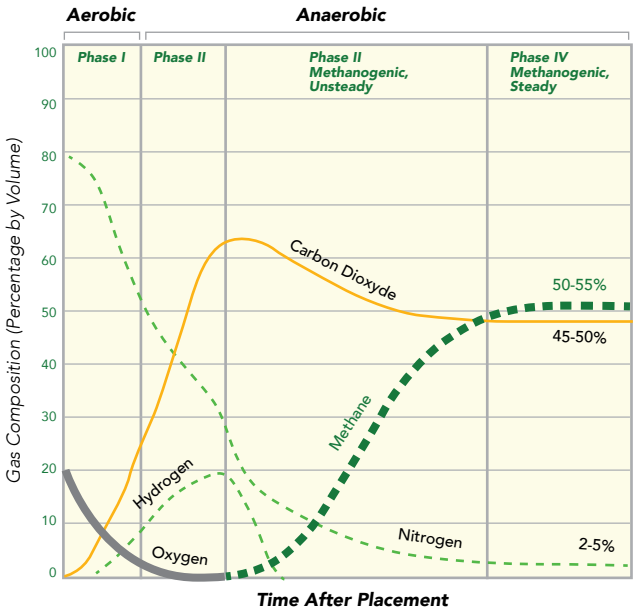
LFG power represents one of the most readily available, cheap and relatively simple forms of waste to energy (WtE) options. Landfills produce gas naturally as organic material is anaerobically broken down to produce methane, carbon dioxide, and hydrogen sulphide. Without control, the methane gas produced will escape into the atmosphere contributing to green house gas (GHG) emissions. To counter this, landfill operators can capture and flare the gas, reducing GHG potential by a factor of 25. From capture and flare to LFG power generation is a small step with significant benefits:

- reduced emissions of GHG that contribute to global climate change;
- use of non-renewable resources offset;
- improved local air quality;
- revenue stream for landfills;
- reduced energy costs for users of LFG energy; and
- job creation and investment in local businesses.

Technology for LFG power generation is cheap and readily available in Indonesia.

Of all the forms of WtE projects available, LFG power is the most widespread in Indonesia to-date.

Approximately 1.87 m3 of LFG is produced per kg of degraded organic carbon (with a 50 % methane content). Organic material in the waste is decomposed in four main phases as shown in Figure 1.



Phase I: *Aerobic - a few days to a few weeks after waste placement*

Phase II: *Anaerobic, non-methanogenic - one month to 1 year*

Phase III: *Anaerobic, methanogenic, unsteady - a few months to 2-4 years*

Phase IV: *Anaerobic, methanogenic, steady – 10 to 30 years*

***Figure 4.1**: LFG generation and changes over time*

LFG production varies considerably from one site to another, depending on the location and conditions of the landfill. The LFG production rate is determined by the following parameters:

Temperature

Methane producing bacteria are temperature sensitive; activity increases with temperature and there are generally two types of bacteria in operation: Mesophillic, which operate in the range 30-35°C and Thermophillic, operating at between 45 – 65°C. Temperature levels in Indonesian landfills tend to be higher and remain steady throughout the year, compared to Europe and America, due to the tropical climate.

LFG production varies from site to site, influenced by factors such as temperature and moisture content…

Moisture Content

Methane generating bacteria live in a thin film of water surrounding waste particles. These bacteria are very sensitive to moisture levels; if the waste is too dry bacterial activity will slow down, if the waste is saturated bacterial activity will stop all together. Moisture control is a key element of landfill management.

…the age and composition of the waste…

Waste Composition

High organic content is good for gas production. Indonesian waste generally contains around 60 % organic content. The type of organic material affects the speed of breakdown and therefore gas production. Wood and paper will decompose slower than vegetable matter.

The Age of the Waste

LFG production reaches its maximum capacity after 3–8 years and normally decreases after 15–30 years. The project planners have to model the potential gas curve (see section 4 below) to determine the economic operating life of the project.

The Structure of the Waste

Microorganisms concentrate on the surface of waste particles; smaller particles of organic material provide a larger surface area allowing more rapid gas production.

The Landfill Cover

…and how effectively the anaerobic conditions are maintained.

Landfills must be covered with a suitable, low-permeability clay or membrane capping material to keep out atmospheric air and rainwater, which will disturb the anaerobic conditions.

LFG power projects are easily scalable and are suitable for both large municipal landfills and small district landfills.

***Figure 4.2**: LFG to power project, Bantargebang, Indonesia*

The Size and Location of Landfills

Small district landfills may produce enough power for internal site use but not meet the benchmark 1MW required for a grid connection. In this chapter and the rest of this guidebook we therefore concentrate on WtE for connection to larger grid connection schemes.

LFG power facilities must be close to landfills to minimise piping distance and near to the main electricity grid to minimise transmission line costs. Many of Indonesia's landfills are already struggling for space to meet basic operating needs, such as leachate treatment plants (LTPs), internal access, materials recovery facilities and office buildings. Designers need to find a dedicated area within the site to locate the LFG power facilities.

4.2 LFG TO POWER SYSTEM TECHNOLOGY

LFG to power systems are relatively cheap and easy to set up by a competent project team. Careful monitoring and management of the system is required to maintain optimal gas flow and power production. The LFG power system can be broadly broken down into two main components: the gas capture and conveyance system, and power generation. In the following sections we look in more detail at these components and their applicability to the Indonesian environment.

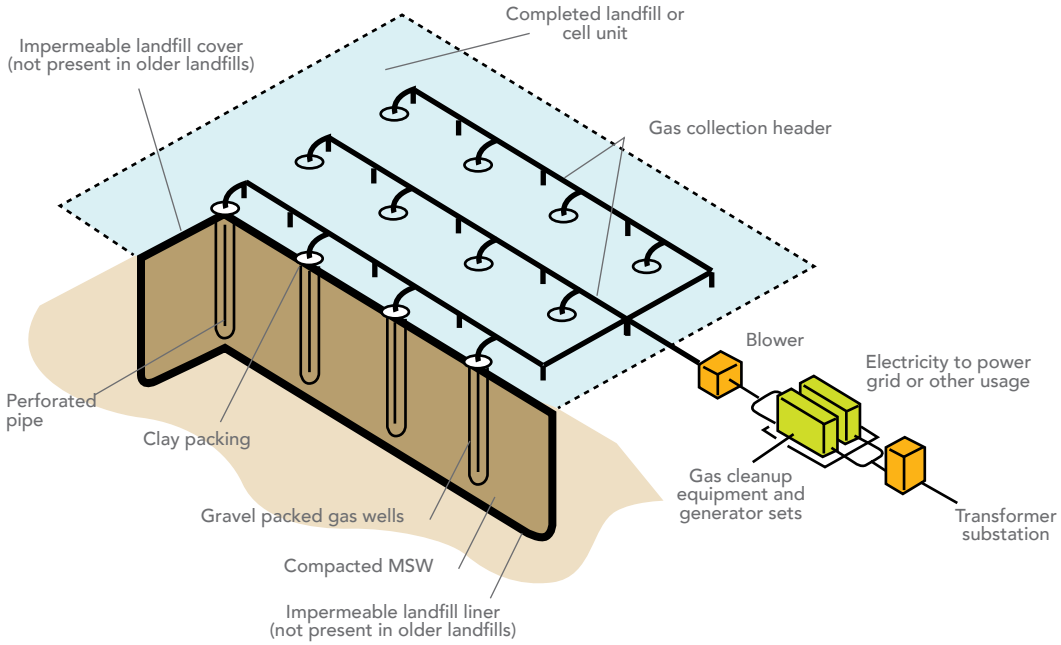


***Figure 4.3**: Typical layout of landfill gas to power generation system and components*

4.3 THE GAS CAPTURE AND CONVEYANCE SYSTEM (GCCS)

The decision whether and when to install the gas collection in an operational landfill is critical to the success of the WtE project.

LFG collection typically starts after a landfill cell is full and has been capped and closed. The capping and closing of the cell contains the gas, and cell closure usually marks the stage where the landfill moves from aerobic to anaerobic conditions and gas production commences.

It is possible to install collection infrastructure and to collect gas whilst the site is operational, however this requires greater resources, materials and planning, if it is not to get in the way of the landfill operations, or be damaged by heavy plant and vehicles. Extraction rates also need to be carefully controlled, since there is a far greater risk of drawing air through the waste mass and potentially causing hot spots and fires.

The design, construction and operation of the GCCS are critical to project performance. These tasks must be performed by trained personnel. Operation requires periodic monitoring and adjustments to the GCCS, to adapt to changing site conditions.

Critical to the success of the project will be the design and layout of the GCCS. The purpose of the GCCS is to extract LFG from the waste mass and convey it to a combustion device for flaring or energy use. The GCCS typically includes the following primary components: extraction wells; a system of lateral and header (manifold) piping to convey the collected LFG; a condensate management system; a blower and flare system; monitoring devices; and system controls. We will look at these components in more detail below:

Extraction Wells

LFG is typically extracted from landfills using a series of vertical perforated pipes, horizontal perforated pipes, or, in some limited cases, from beneath a membrane covering the landfill under which the produced gas is collected. Whilst each gas collection system has advantages and disadvantages, a combination of systems will often be employed together within a landfill gas extraction field.

Vertical wells are easy to install after landfill operations have ceased, thereby avoiding disruption to tipping operations and minimising damage to the capture infrastructure.

Vertical wells are the most common form of active gas collection, extracting the gas through vertical perforated pipes. This is the simplest, most reliable method of LFG extraction. Typically, these are retrofitted to the closed cell using a bucket auger or similar. The well diameter is usually within the order of 35–100 cm. After drilling, a perforated polyethylene pipe with a diameter of 9–15 cm is placed in the middle of the hole, and gravel is filled in around the pipe. Vertical extraction wells are typically placed 30–80 meters (m) apart, depending on a number of factors, including the landfill depth, waste density and waste permeability in order to optimise gas capture across the landfill. The advantage of vertical pipe systems is that they are easy to install after landfills are finished, which is not possible with horizontal pipes.

***Figure 4.4**: A bucket auger in operation*

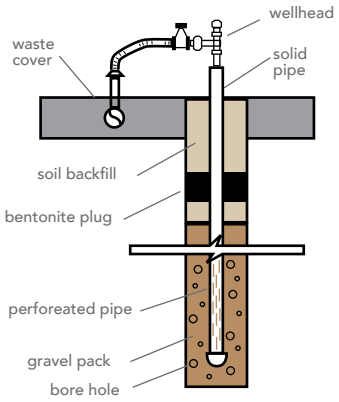


***Figure 4.5**: Typical vertical well design*

There are examples in Indonesia of wells being installed (both for gas collection and drainage) prior to the landfill being filled. However, these wells are exposed and prone to damage during waste placement and the survival rate is low.

***Figure 4.6**: Gas wells installed prior to landfilling, Meulaboh TPA, Aceh, Indonesia*

Horizontal wells can be installed on a working landfill to extract gas at the peak of production in the early stage of anaerobic digestion.

Horizontal wells are constructed by digging trenches in the surface of an operating area of the landfill waste cell. Trenches are typically excavated to accommodate a 70 cm wide and 100 cm deep bed of gravel or aggregate with a perforated pipe running through the centre. A section of solid (blind) pipe is used at the end of the horizontal well before it reaches the edge of the waste mass to inhibit air intrusion. The length of this solid pipe varies with the site configuration. The solid pipe may also be surrounded by bentonite to prevent air infiltration into the waste mass once a vacuum is applied to the well. After the horizontal well is constructed, waste can continue to be spread over the well. After approximately 4 m of waste has been placed on top of the horizontal well, a vacuum can be applied to the well. One of the main advantages of horizontal wells is that they can be installed on a working landfill and are therefore able to extract the very early peak of gas production associated with early stage anaerobic digestion. Another key advantage is that, since the gas collectors do not impede landfill operations, landfilling can continue without affecting gas collection.

***Figure 4.7**: Horizontal wells, Sarbagita Landfill, Bali (the circle highlights a horizontal well)*

***Figure 4.8**: A horizontal well and collector, USA*

***Figure 4.9**: Installation of a horizontal collector in a trench, Thailand*

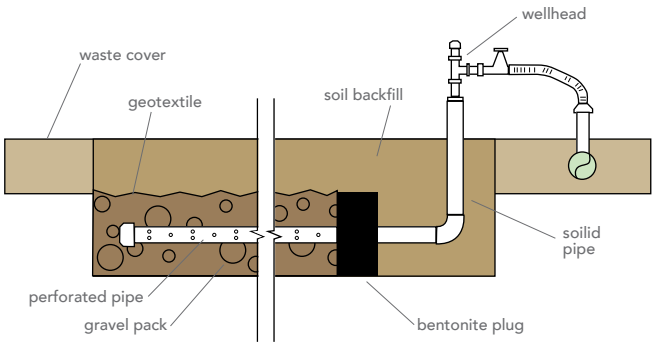


Figure 4.10: Typical horizontal well design

The main problem with horizontal extraction pipes is that leachate can enter the pipes and, along with condensate, can pool in blind sections of the pipe blocking the well. This can be mitigated by an efficient drainage system and a carefully controlled slope (which must take potential waste settlement into account).

Wells installed for gas collection and drainage prior to closure of the landfill are exposed and prone to damage.

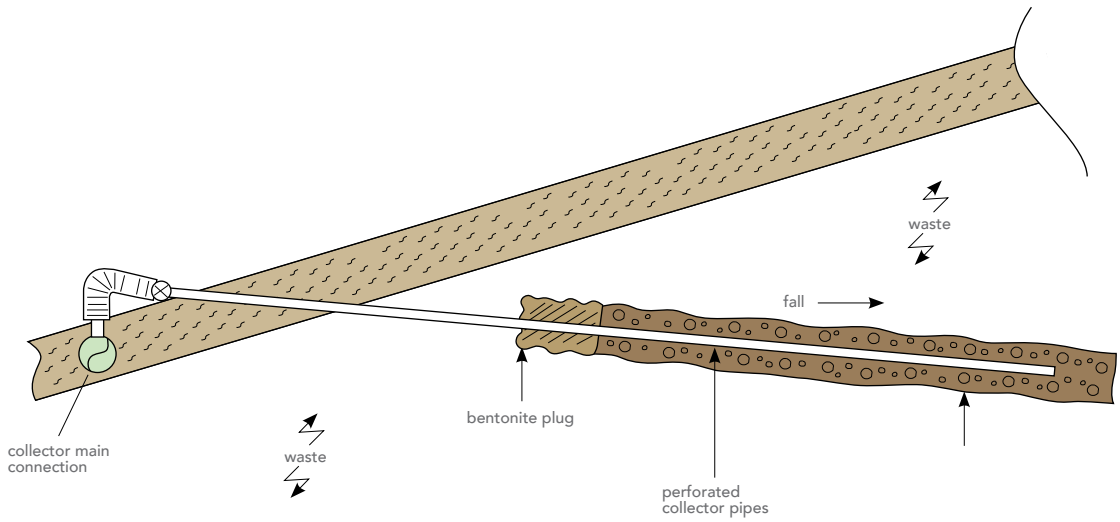


***Figure 4.11**: Typical installation detail, where the fall back into the site allows liquids to drain back to the waste mass*

Pin wells are one of a number of alternative gas extraction methods, which use a low-cost installation method to provide coverage in relatively shallow waste, often as a temporary or interim solution. They are also known as 'push in wells' or 'spike wells'. Pin wells are generally installed at quite close spacing, typically between 10 m and 20 m, and flows can be quite substantial.

Pin wells are most easily and cheaply installed using a spike driven or hammered into the waste but an auger is the better option in terms of better gas flow.

The basis of the technique is a steel 'pin', or 'spike' made from thick walled steel pipe of approximately 125 to 150 mm diameter and perhaps 6 m long, with a point formed at one end. The pin is driven into the waste using an excavator which may have a special adaptor plate fitted for the purpose, or, for maximum productivity, a hydraulic hammer attachment. The spike is driven into the waste and retracted, leaving a hole, within which a well screen is installed with pea shingle surround and a bentonite seal at the top. Using appropriate equipment and depending on site/waste conditions 15 or more such wells can be installed in a 10 hour shift.

Generally the well screen is a 63 mm or 2" pipe connected to the system with similarly sized flow lines.

A membrane cover can also be used to take advantage of early gas recovery from newly closed or temporarily closed cells, as has been applied at Bantargabang landfill, Jakarta, Indonesia.

An alternative method of installation is to use a small diameter auger or flight auger to form the hole and then to complete the installation as described above. This method may be less likely to 'smear' the face of the waste in the hole with the result that flow may be improved. However, drilling time and moving between holes may take longer.

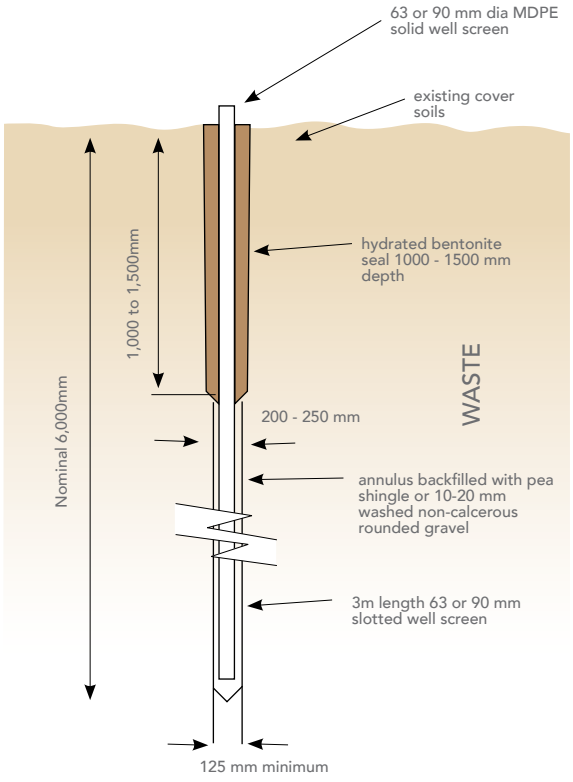


***Figure 4.12**: Typical detail of a pin well installation*

***Figure 4.13**: Pin well installation using an excavator*

Membrane covers made of impermeable material are sometimes used to cover the landfill but are not in themselves a collection system. This method is extremely efficient at improving the rate of collecting the gas being generated (O'Brien, 2008 estimates up to 90 % gas recovery). A membrane is an interim solution to air and rainwater ingress and greatly facilitates collection by reducing the extent of air ingress through the soil cover material. In addition

to improving the efficiency of a vertical or horizontal collection system, perforated pipes can be laid beneath the membrane, basically to 'scavenge' any gas, which may still be escaping through the soil. This further improves collection efficiency and prevents gas escaping through holes and joints in the membrane and also prevents the membrane 'ballooning'. It can significantly assist in the management of odours caused by gas emissions through the surface on very active sites. However, this is an expensive solution and the membrane liner is prone to damage by livestock or heavy equipment, if proper site controls are not in place. Another potential disadvantage, if this system is used long-term in drier climates, is that the membrane limits water penetration, reducing the moisture content of the waste. While this results in a drop in gas production (we return to this later in the chapter), it is unlikely to be a significant issue in Indonesia, where the waste is already saturated at the disposal point and rainfall is high.

***Figure 4.14**: Example of a membrane covered gas extraction system being used in combination with vertical wells, Bantar Gebang, Indonesia*

***Figure 4.15**: Extensive use of an interim membrane cover on a large landfill in Hong Kong*

For ease of reference we summarise the advantages and disadvantages of the different gas collection systems described above in table 4.1 below.

System	Methodology	Advantage	Disadvantage
Vertical drilled wells	Installed using a bucket auger or rotary drill. Perforated central pipe surrounded by gravel pack.	Minimal disruption of landfill operations, if placed in closed area of landfill. Most common design. Reliable and accessible for inspection and pumping. Small diameter and relatively shallow wells can be drilled at reasonable cost as an interim collection measure.	Increased operation and maintenance required, if installed in an active area of the landfill. Delayed gas collection, if installed after site or cell closes.
Built-up wells	Often constructed using concrete rings or stone filled gabions with a well pipe in the centre and granular fill in the annulus.	Provides accessibility from the base of the waste mass. Can be large enough to allow access to pump leachate. Can be used in final system. Encourages leachate drainage to the basal layer.	Interim use often hampered by making an effective seal at depth in the waste. High risk of air ingress, which is worse when surrounded by high permeability waste. Obstruction during operations. Difficult to maintain 'verticality' in deep sites. Compaction around well poor. Cannot be installed over existing landfill slopes. Needs base foundation system to transfer load to base safely without damaging liner. Poor 'survival rate'.
Pin wells	Small diameter casing installed within granular annulus in hole preformed by inserting and removing a steel pin into the waste. Can also be installed using small diameter drilled boreholes.	Low-cost, quick installation. Effective remedial measure for near surface issues. Useful sacrificial system.	Design must incorporate effective bentonite sealing to be useful. Insertion depth limited. Close spacing required.
Horizontal collectors	Perforated pipes laid within granular pack and covered over by waste as it progresses.	Facilitates earlier collection of high-yield gas. Low-cost and reduced need for specialised installation equipment. Allows extraction of gas from beneath an active tipping area on a deeper site. Can be effective over large areas.	Increased likelihood of air intrusion until sufficiently covered with waste. More prone to failure because of flooding, condensate collection or landfill settlement. Liquid separation often required at each well head/pipe end. Flow often intermittent. More easily subject to sudden failure than vertical wells.
Membrane connections	A simple connection of a piece of pipe through a 'patch' of membrane welded to the interim or permanent cap to allow extraction from immediately below the membrane.	Simple to install. Can be installed where required and connected easily using small diameter flow lines (63 mm or less).	Requires presence of a proficient polyethylene (PE) extrusion-welding technician. May need support to prevent pipe movement placing stress on the liner or the patch. High risk of drawing in air through failed joints or torn membrane

***Table 4.1**: The advantages/disadvantages of different gas collection systems*

Gas Well Heads

Because waste is not homogenous and the conditions within the waste mass can vary considerably, each gas well behaves differently and can have very different characteristics to its neighbours. Gas collection has to be monitored and controlled from each individual gas well; this can be done at the connection between the collector and the gas conveyance network (i.e. immediately at the well head) or at a collection manifold. Many different designs are available of varying complexity and cost. Some include flow measurement using a built-in pitot tube or an orifice plate, while others are much more simple. The minimum requirement for monitoring is a sample point, which allows a gas sample to be taken with a portable gas analyser, as well as measurements of relative pressure within the system. Flow measurements are a great advantage to further understanding the gas field operation and balance and it is recommended that provision is made for flow to be measured.

The gas being produced by the waste mass has to be monitored at each well head and it is recommended that this should include flow rate measurement.

***Figure 4.16**: Relatively simple gas well head with sampling points and control valve, attached to conveyance system by reinforced flexible hose.*

***Figure 4.17**: Very simple connection leading to a collection manifold where monitoring and control occurs*

An alternative to monitoring and controlling at the well head is to use a collection manifold, where a number of gas wells in an area are connected via individual control valves to the conveyance system at a single point. The advantage of this system is that a technician can quickly monitor and adjust many wells, minimising time walking over the site, which also reduces the risk of trips and falls. Such a system must also be backed up by regular inspections of the gas wells to ensure they are maintained in good operating order.

LFG power projects are heavily reliant on good landfill management and well head monitoring should be backed up by regular physical inspections to ensure the well heads are operating effectively.

***Figure 4.18**: An example of a pumped well head (the blue flexible hose is for removal of leachate via a submersible pump within the gas well; gas is taken from the connection at the side and controlled using the butterfly valve)*

***Figure 4.19**: A typical manifold arrangement featuring small sample valves and larger access points for inserting flow measurement instruments*

If gas collection is not started during landfilling operations, it should take place as soon as possible after the cell has been closed and the gas well field installed in order to minimise gas loss and emissions to the atmosphere.

Gas Conveyance Networks

At the head of each gas well a pipe connection feeds gas into a conveyance network linking the wells across the gas field and feeding them via a main delivery pipe to the flare and/or power generation plant. The conveyance system consists of a network of headers and lateral pipes. The well field project team needs to plan the arrangement of wells carefully to maximise gas collection and arrange the collection/conveyance system across the landfill to allow vehicle access to the site, minimise exposure and risk of damage to the pipe network, and maintain sufficient slope to prevent pooling of condensate and network blockages.

Interim Conveyance Networks

It is often necessary in working landfills to install interim pipe conveyance networks to take advantage of early gas recovery and changing well field layouts. In this case, UV-resistant welded high-density polyethylene (HDPE) pipes are laid over the surface of the waste/cell, feeding into the central landfill gas treatment/flare/power facilities. The programming, routing and size of interim pipework is dictated by a number of factors, including:

- the landfill filling plan;
- surface water drainage structures;
- access roads;
- plant movements;
- gradients and the need for condensate management;
- the interim capping programme;
- the final capping programme; and
- the number and type of wells to be connected, and their expected landfill gas flows.

We consider the advantages and disadvantages of permananent (buried) and temporary (surface) gas conveyance systems.

Another key advantage of temporary conveyance systems, as evidenced by Indonesian LFG projects, is that uncertain landfill operation conditions mean that many wells have a short life and uncertain yield, often being over-tipped earlier than expected or becoming flooded and unproductive. The well field is therefore constantly changing and a temporary surface conveyance network allows well field managers to respond quickly and easily to changing conditions at minimal cost.

Care must be taken with livestock which may be present on the landfill. Cattle and goats can damage gas wells by rubbing against them, potentially breaking sampling valves and connections and causing control valves to be moved from their set positions.

***Figure 4.20**: Cows are a common and constant problem on landfills in Indonesia*

Permanent Conveyance Networks

As the landfill matures and cells close, the LFG well field management team can plan permanent connections to take advantage of long-term gas yield. Largely, the same principles apply to planning a permanent conveyance network as with a temporary network. Permanent pipe networks can also be placed on the surface of the closed cells; however burying the pipes provides advantages of better network protection and longer working life. When planning a permanent conveyance system well field managers must be careful to allow sufficient slope for drainage of condensates, which form when the saturated landfill gas from the well cools in the pipework. Landfills settle over time as waste degrades and blockages can occur as settlement reduces pipe gradients. Pipe slopes of 3 - 5 % are recommended as a minimum and, where possible, settlement should be anticipated by providing greater gradients

We summarise the advantages and disadvantages of permanent and temporary conveyance networks in Table 4.2 below.

Conveyance Network	Advantages	Disadvantages
Interim (surface)	Quick and easy to install. Flexible and able to respond to changing landfill and well field conditions. Easy to add/remove connections. Easy to monitor and adjust as all pipes exposed.	Exposed and prone to damage from livestock, traffic, and surface fires. Exposure to sun requires UV resistant pipes and careful monitoring of connections/joints for expansion/contraction damage.
Permanent (buried)	Does not impair surface water flow. Less likely to be damaged by traffic, livestock and surface fires. Allows easy vehicle access across the site, provided suitable crossings are designed and marked. Will not suffer UV damage or temperature expansion/contraction.	Difficult to locate and fix leaks and blocks. Relatively expensive to install. Difficult to adjust slopes in the event of landfill settlement. Requires careful planning to ensure good flow and continuity between cells completed at different times

Table 4.2: *The advantages/disadvantages gas conveyance networks*

Typical Gas Collection System Maintenance

Of all the components of the LFG energy system, the gas collection system is subjected to the greatest stress from a variety of sources, including system blockage or collapse caused by waste settlement, material wear and/or failure (including ultraviolet degradation of pipes, fittings and well heads, or degradation of blowers and generators from corrosive gas elements), and damage resulting from operational hazards, such as heavy equipment and vehicles coming into contact with the wells and piping. In Indonesia another common factor impacting infrastructure is the presence of livestock on the landfill. Cows and goats can puncture geo-membranes and damage well heads. Typical gas collection system maintenance activities include:

Formal maintenance scheduling and record keeping are important to ensure that maintenance occurs as scheduled, or as needed, and is documented.

- checking for gas-tightness of connections and joints;
- repairing or replacing damaged wells and valves;
- removing leachate and condensate blockages;
- repairing system components damaged by vehicles or livestock;
- re-grading or replacing pipes affected by settlement of the waste mass;
- replacing components that have failed as a result of aging or fatigue.

Many of the above activities can be planned to take place with minimum interruption of system activity, if they are picked up swiftly or in advance by careful and regular monitoring. Major repairs may require a temporary system shutdown, which, where possible, should be planned for off-peak times.

4.4 GAS TREATMENT

The gas collected must be treated to remove products which could damage generating and flaring equipment.

All LFG systems need to remove condensate upstream of the gas booster and utilisation plant. Depending upon the content of the waste within the landfill, it may also be necessary to clean other harmful contaminants from the gas stream. As discussed above, condensate must be controlled to prevent pipeline blockages, and both condensate and contaminants have the potential to damage blowers and generators, if not properly managed.

Stage 1 – Condensate Removal

LFG is saturated when it exits the gas extraction well. As with very humid air, condensate is produced when landfill gas cools - in the same way that water droplets can be seen to form on the outside of a cool drink glass or can when brought into a humid atmosphere. The amount of condensate is dependent on a number of factors, including gas temperature and pressure. The higher the pressure and the lower the temperature relative to the conditions of the gas as it exits the gas well, the greater the volume of condensate that is produced. It is possible to calculate this volume using psychometric charts, but this is generally only required when sizing a specific pumping requirement, perhaps in a gas pre-treatment process where high pressure and low temperatures may be used to maximise condensate removal. As LFG is collected from the waste mass, it may start to cool in the pipework causing condensate precipitation, particularly when the system is cooler at night for example. The condensation that forms can restrict or completely block the flow of LFG in the GCCS, particularly where there is insufficient pipe slope or dips in the pipeline.

This includes removal of the condensates and leachates which build up in the collecting pipes.

Although not specifically related to condensate, there is also the possibility that an actively gassing site with high leachate levels may eject leachate from the gas wells into the gas collection system pipework, from which it must be removed, along with the condensate. Often more leachate is ejected into the pipe than condensate.

Well field managers must design the conveyance system with sufficient slopes to channel condensate to designated low points, where it can be removed from the system by vacuum-sealed sump pumps or allowed to drain back into the waste mass. Well field managers will often use a system of 'in-line dewatering' with a number of condensate removal points within the GCCS. As stated above, a minimum slope of 3 % to 5 % will facilitate condensate drainage whilst allowing for some settlement of the waste settlement. If drained back into the waste mass, the condensate low point must include a vacuum trap to prevent air from being drawn into the header. The trap must provide a sufficient vacuum break to match the maximum expected applied vacuum on the system (plus a safety factor). A 'condensate

knockout pot' or 'slug-catcher' is often used before the blower and generator. This is a large cylindrical vessel that reduces the gas velocity sufficiently that any condensate in the gas stream is 'dropped' and can be removed in conjunction with a demister pad to remove any droplets which could get carried over to the blower.

***Figure 4.21**: Examples of large condensate knockout pots used to deal with 10,000m3/hour of landfill gas in Hong Kong*

In hot climates, such as Indonesia, where ambient cooling is limited, it is sometimes necessary to cool the gas further using chilled water and a heat exchanger to remove more moisture from the gas. This is particularly important for some engines that use an intercooler between the turbocharger and the inlet manifold and where acidic condensate may form and cause significant damage.

Collected condensate is pumped to one or more storage tanks until it can be combined with leachate for treatment or disposal or mixed with the influent to the leachate treatment plant.

A single system or a combination of systems, involving physical and chemical treatment, can be employed to remove contaminants from the gas stream.

Stage 2 – Contaminant Removal

***Figure 4.22:** Duty and standby dewatering pots at the powerhouse, Bantergebang*

Even after the removal of condensate the gas stream may still contain harmful contaminants, including chlorine, fluorine, sulphur, organic silicon compounds, hydrocarbons and ammonia, all of which can damage blower and generator equipment. To clean all contaminants effectively from the gas stream can be an expensive process and this has to be one of the deciding factors when selecting blower and generator technology. It is important to obtain gas samples for reliable trace gas analysis when considering gas utilisation projects.

Treatment methods include: activated carbon absorption; liquid hydrocarbon absorption, chemical (various), biological desulphurisation, water washing and gas cooling, and water knockout. Each has its advantages and disadvantages and must be considered on its merits for the particular site and the serviceability of the process.

The Blower

The blower generates the vacuum required to extract gas from the waste mass and pushes the gas towards the flare or power generation unit; as such, it is a critical part of the GCCS.

The blower is a critical part of the GCCS. The blower is a pump which provides the vacuum used to collect LFG from the waste mass. It also provides the pressure necessary to push the LFG to the flare or to the power generation unit. It is usual for the blower to be located at the head of the LFG collection system, near to the flare and generator house. Depending on the size requirement, blowers and flares are often provided assembled on a common skid, which is a very convenient system for rapid installation and re-deployment. The gas flows to the blower where the vacuum at the inlet is adjusted to meet the requirements of the GCCS and the outlet pressure of the gas is adjusted to conform to the requirements of the flare and/or generator. The LFG typically passes through a metering system to measure the flow rate of LFG being collected by the GCCS. Basic metering systems include a volumetric flow meter. However, a continuous methane monitoring system also would be needed to measure the mass flow rate of methane in the LFG, should this be a requirement.

Gas Flares

Flares must be installed away from any trees, power lines or other objects that could be ignited by the flame or damaged by heat.

***Figure 4.23**: A 'candlestick', 'elevated' or 'open' LFG flare*

A gas flare is a device for igniting and burning the collected LFG providing a means of controlling harmful gas emissions and odours, and of mitigating other environmental or health concerns.

There are two types of flare available: the open, or candlestick type, or the enclosed high-temperature flare, which is generally a regulatory requirement in many countries. Open flares are less costly and useful for an immediate solution to a problem because they can be more readily supplied as portable units. The enclosed flare, as its name suggests, burns all the gas within the combustion chamber of the stack and at high temperature, giving a much more controlled destruction environment to achieve over 99 % methane and volatile organic compound (VOC) destruction. For this reason, the enclosed flare is a vital component for the effective destruction of GHG and is specified as a requirement in GHG control programmes. Burning landfill gas in an enclosed flare reduces the GHG effect of landfill gas by a factor of 25.

Gas flares are a useful component of an LFG energy system and are typically used to control LFG emissions during start-up and downtime of the power generation system and to control gas that exceeds the capacity of the generator plant. In addition, a flare is a cost-effective way to gradually develop the extraction capacity of a system on an active landfill. As more waste is placed in the landfill and the gas collection system is expanded, the flare is used to control excess gas between power generator system upgrades (for example, before the addition of another engine) to prevent methane from being released into the atmosphere.

Safe and effective operation depends on sound design and adherence to strict electrical codes for equipment for use in hazardous areas and the inclusion of sufficient monitoring and safety measures.

Figure 4.24: *Examples of high-temperature enclosed landfill gas flares*

There are a number of manufacturers who are specialised in LFG flare design and construction and who can provide a complete service through to commissioning.

Often integral with the gas flare is the gas blower, or booster, which provides the motive force to extract the gas from the landfill and deliver it to the flare or to the utilisation plant. The blower duty must be designed taking into account the expected flow from the gas field and the suction effort required to overcome the friction in the gas conveyance system, the suction required to 'drag' the gas from the waste mass, and the pressure requirements of the flare and/or utilisation plant.

Modern, purpose-designed landfill gas flares can be very reliable and run without significant attention, other than preventative checks and lubrication.

Typical Maintenance Regimes for Blowers and Flare Systems

Blowers are subject to vibration, belt wear, bearing deterioration, seal damage, and corrosion. Wear necessitates regular routine and scheduled maintenance, as well as particular attention to sounds during system start-up and shutdowns. Given that the blower drives the gas supply for the generating station, it follows that selection of appropriate technology and regular checks and maintenance are key to a reliable supply of gas to the generating plant. Flares are subject to thermal stress that can be exacerbated, if the flare is operated at temperatures or flows above manufacturer recommendations. Maintenance generally involves inspecting the flare for heat damage, maintaining pilot fuel and igniters, preventing condensate build-up and checking the general mechanical condition. Source testing can be used to assess flare performance.

4.5 LFG MODELLING

Accurately projecting total LFG and methane generation for a landfill can be very difficult and is better carried out by a specialist who is able to use the most appropriate input data on a specific site by site basis.

Estimating the volume of LFG generation from a landfill is a critical component of project assessment and conceptualisation because the collection projections are used to estimate the size of the project, expected revenues, project design requirements and capital and operating costs.

Modelling requires selection of the most appropriate modelling software/system, consideration of local conditions that affect LFG generation and an understanding of the uncertainty inherent with LFG modelling. The value of LFG estimates also depend on the quality of data used in the model and proper consideration of factors, such as annual waste composition, disposal rates and estimated growth rates and landfill management.

Since the 1980s several models have been developed to estimate LFG production and extraction. These models include the simple zero order model (limited and linear), the first order model (Scholl Canyon Model), and the most recent, the multi-phase model, described below.

The First Order Decay Model provided by the Intergovernmental Panel on Climate Change (IPCC) is considered by many to be an accurate model as it calculates the emission of methane in tonnes per year from the decay of biodegradable carbon in the waste. The IPCC model was developed for use in connection with the United Nations Framework Convention on Climate Change (UNFCCC) rules for emission reduction from landfills in Clean Development Mechanism (CDM) projects.

Accepted models are built into commercially available modelling software packages, such as the US Environmental Protection Agency (EPA) Landfill Gas Emissions Model (LandGEM), version 3.02.

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in MSW landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from US landfills, however field test data or other user-provided values can also be used in place of model defaults. The US EPA Landfill Methane Outreach Programme (LMOP) has produced models with default values appropriate for a number of countries, including China.

Apart from the waste input rate over time, the model requires the user to select the values for the 'speed' of the decay process - the 'k-value' and the extent of landfill gas formation given by the 'Lo-value'.

The rate of decay depends on a number of factors, including:

- the availability of nutrients to the waste mass;
- the pH of the waste;
- the moisture content of the waste mass; and
- the temperature of the waste mass.

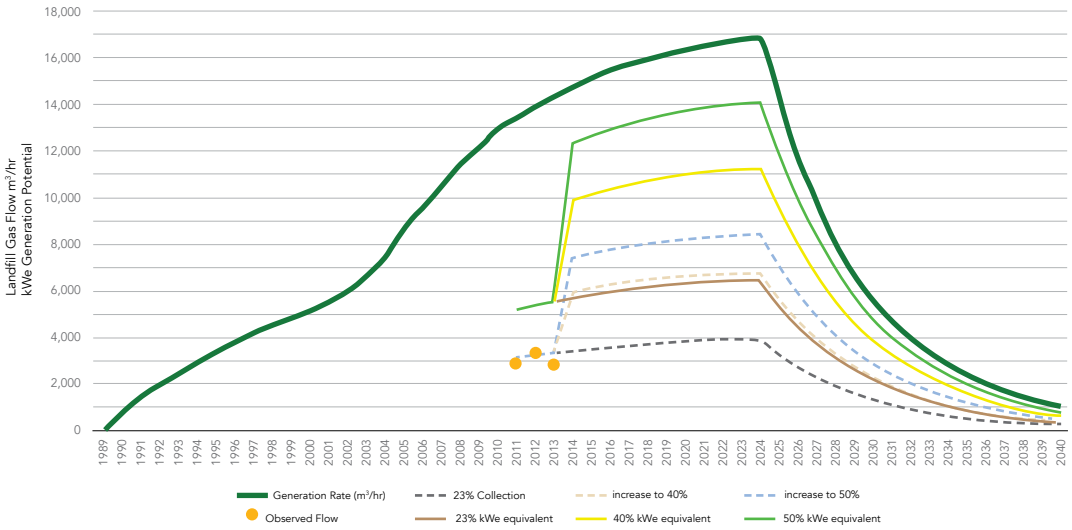


***Figure 4.25**: Example of LFG yield from Bantar Gebang, Jakarta, Indonesia, using the LandGEM model to estimate gas production*

4.6 GENERATOR TECHNOLOGY

Electricity is produced by burning landfill gas (LFG) in an internal combustion engine, a gas turbine, or a micro-turbine. Other technologies, such as Stirling Engines, are under development, but are not yet commercially viable. Other utilisation methods include combined heat and power (CHP) plant for heating or absorption chilling, or direct use in a gas boiler to produce hot water or steam for space heating or process heat. Other uses of LFG include infrared heaters and compressed natural gas (CNG) as fuel for vehicles, or for injection into the national gas main, although this requires costly treatment to upgrade the gas.

As a rule of thumb, 210 m^3 per hour of LFG are needed to produce 350 kW of electricity, with 720 m^3 per hour needed to generate 1,200 kW.

Internal Combustion Engines

Internal combustion engines are the most commonly used technology for LFG power projects and have a number of advantages:

- robust, proven technology;
- easy to maintain, with readily available spare parts;
- relatively low cost and high efficiency;
- wide range of engine sizes suitable for small district landfills up to large regional landfills;
- modular and scalable to match growing landfill requirements; and
- can be readily containerised, allowing simple installation and re-deployment.

Internal combustion engines are a proven, flexible, efficient and robust technology in LFG power projects and are relatively low cost and easy to maintain.

Internal combustion engines have generally been used at landfills where gas quantity is capable of producing 500 kW to 10 MW, or where sustainable LFG flow rates to the engines are approximately 0.2 to 1.6 million cfd at 50 % methane. Multiple engines can be combined for projects larger than 1 MW. Table 4.1 provides examples of commonly available sizes of internal combustion engines.

Output (kW)	Gas Flow (m^3/hr @ 50% Methane)
325 kW	195
540 kW	324
633 kW	380
800 kW	480
1.2 MW	720

***Table 4.3**: Gas flow rates and power output figures for internal combustion engines*

While Indonesia is well supported by suppliers of gas engines and spare parts, the same cannot be said of more sophisticated technologies, such as gas turbines.

More recently in Europe a number of smaller engines are being installed to take advantage of the renewable power incentives, with the result that generators of 50, 150 and 205 kW are being used.

Gas engines, which are covered below, are often used even in large-scale plants because they can be built in modules/containers of 1 MW units. Indonesia already has a good network of gas engine distributors who can supply suitable engines, spare parts and service support for LFG power projects. This is not the case for more sophisticated technologies, such as gas turbines.

***Figure 4.26**: A Jenbacher 1 MW gas engine at Bantergebang*

In Table 4.2 we show typical capital and annual operating and maintenance costs of large and small internal combustion engines, gas turbines and microturbines.

Technology	Typical capital costs ($/kW installed)*	Typical annual O&M costs ($/kW)*
Internal combustion engine (> 800 kW)	$1,800	$180
Small internal combustion engine (< 800 kW)	$2,400	$220
Gas turbine (> 3 MW)	$1,800	$180
Microturbine (< 1 MW)	$2,800	$230

***Table 4.4:** Capital and O&M costs of gas burning power generators*

** 2013 dollars kW: kilowatt MW: megawatt* *Source: U.S. EPA LMOP. LFG cost-Web, Version 2.2.*

Gas Turbines and Microturbines

Commercial-scale LFG gas turbine projects can be found operating in developed regions, including the USA and Europe. LFG-fired gas turbines are similar to natural gas turbines except that, because of the lower quality gas, twice the number of fuel regulating valves and injectors are used. The majority of gas turbines currently operating at landfills are simple cycle, single-shaft machines. Gas turbines generally have larger outputs than internal combustion engines and are available in various sizes from 1 MW to more than 10 MW.

Producing the required LFG pressure can consume a significant portion of the power being generated, resulting in lower energy conversion efficiencies (parasitic losses).

In recent years small gas turbines, known as micro-turbines, have been introduced, producing as little as 30 kW of electricity. However, they are not normally the primary generating unit. Most LFG power projects using turbines in the USA and Europe are in the 3 to 5 MW range, which require sustainable LFG flows in excess of 2,000 m^3/hour. Gas turbines are available as modular and packaged systems, allowing for flexibility when responding to changes in LFG quality and flow.

Gas turbines require a high-pressure fuel supply in the range of 11 to 14 bar gauge (barg) and for this reason a Fuel Gas Compressor (FGC) must precede the turbine. The FGC is a more sensitive piece of equipment than a blower in terms of the efficient long-term reliability of the facility. Requirements for the compression stage typically govern the level of LFG processing necessary to ensure reasonable operating and maintenance costs for the facility.

To-date there are no gas turbine lfg projects operating in Indonesia due to lack of suitable sites, high capital and operating expense and an absence of suppliers and spare parts.

At present, no gas turbine projects are operating in Indonesia and there are few sites where they would be suitable. Gas turbines are expensive, sensitive, high-tech equipment. There are currently no suppliers in Indonesia. They require specialist qualified operators, as well as back-up servicing and maintenance crews. Spare parts are expensive and also not available locally. The equipment is sensitive and, if not properly operated and maintained, will quickly breakdown. Repair bills can be prohibitively expensive and system down-time extensive.

Chapter Checklist	✔
Now that you have read this chapter:	
Do you know what the most suitable capture, transportation, processing and generating technologies are for use in Indonesia?	
Does your landfill have the right conditions to generate sufficient quantities of landfill gas?	
Do you have the right systems and technology in place to capture and transport the gas safely and efficiently?	
Does the gas require any treatment or processing before use?	
Do you know how to estimate and model the amount of landfill gas that can be produced from the landfill?	
Do you know what generating technologies are available for producing electricity from landfill gas?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 5

WASTE TO ENERGY TECHNOLOGIES

WHAT THIS CHAPTER IS ABOUT

In this chapter we provide a basic understanding of the commercially available municipal solid waste (MSW) waste to energy (WtE) technologies.

We highlight some of the benefits and weaknesses of each technology with regard to MSW and evaluate their applicability in the Indonesian context.

We look at three methods of thermal treatment (incineration, gasification and pyrolysis), along with refuse-derived fuel (RDF), which is a method of preparing MSW for WtE utilisation.

We advise on how to react to independent WtE technology providers whose primary focus is to promote and sell their systems, rather than address your needs.

THE KEY POINTS

- The factors that influence the selection of WTE technology. *page 81*
- How to make sure that the technologies being offered by suppliers actually meet requirements *page 81*
- The advantages and disadvantages of incineration, gasification and pyrolysis as thermal treatment methods. *page 82*

5.1 CHOOSING THE RIGHT WTE TECHNOLOGY

In summarising WtE technology options, this guidebook is not suggesting that WtE is the most appropriate waste treatment option available to all areas of Indonesia. Not all landfills are large enough, or have the budgets and technical back-up required, to run the kind of WtE technology covered here. It is important that local governments (LGs) conduct a thorough independent assessment of the proposed WtE technology in the light of their existing/planned waste management (WM) infrastructure, in order to produce a detailed feasibility study that identifies the most applicable WM options for their locations as part of the planning required for all the elements of the waste hierarchy.

It is not suggested that WtE is always the right solution to waste management problems. In some cases, other approaches may be more beneficial.

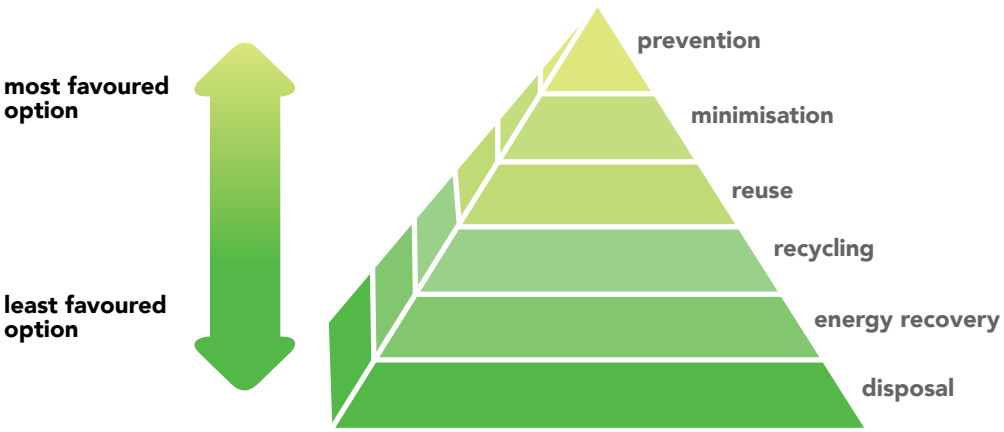


***Figure 5.1**: Choosing appropriate and applicable technologies*

Beware of equipment and technology suppliers telling you that theirs is the ideal solution without proper reference to your specific requirements.

Many factors need to be considered as part of the review and assessment of available WtE technologies, but the topic is far too detailed to be addressed fully here. It is likely that numerous companies will approach you to offer their own WtE technical solutions, probably telling you that their solution is the most efficient, established and/or economically viable solution in the marketplace. But, obviously, not all WtE technologies can be the best for you. Do not be afraid to question potential technology providers about the performance data

they quote, particularly in the case of expensive advanced thermal technologies, and how good a fit the technology is with your actual needs and the Indonesian environment. Below are some key factors you need to consider and evaluate when assessing WtE technologies – a more detailed approach is demonstrated in Appendix II of Reference 7 (see the end of the chapter).

- what is the operational life of the plant?
- can appropriate (quality and quantity) feedstock be guaranteed for the life of the plant?
- what technology is most applicable for the available feedstock?
- is that technology proven – has it been operated at a commercial scale elsewhere in Indonesia and/or other countries at multiple locations?
- do any of those locations display conditions similar to those found in Indonesia (waste types/volume, operating capability/capacity etc.)?
- what products/residues will arise from the WtE process?
- do you have the capability/capacity to manage these products/residues?
- can the technology meet all the performance standards you require, including local/national laws and regulations?
- if your feedstock changes (quantity/composition etc.) can the WtE technology cope with these changes?
- are the technology providers you are talking to credible in terms of engineering and financial credibility?
- will the technology provider also operate the plant?
- if not, who will operate the plant and what technical and financial records do they have that indicate they are capable of doing the job?
- if the plant is to remain under LG management, are there sufficient technically qualified members of staff to run the plant and, if not, what are the training options?
- has the technology provider given clear operating and maintenance (O&M) budget requirements and are these within LG allocations?
- is there a service agreement and local supplier for spare parts?

The 'batman' approach is designed to find the best technogical fit for your specific situation.

Getting Help from Batman

The 'BATMAN' concept, put simply, is an adaptation of the BATNEEC (Best Available Technology Not Entailing Excessive Cost) assessment principle that puts the focus on choosing a technology that is appropriate to your actual needs. It is easy to get carried away with ideas about super high-tech WtE solutions that may lack any proven commercial capability (proven at pilot scale only etc.) or may be commercially proven but be completely unsuitable for the technical, economic and waste characterisation issues that Indonesia faces. The most appropriate solution for you may not be the most complex or newest technology, but it should meet the actual needs you have:

BEST
AVAILABLE
TECHNOLOGY
MEETING
ACTUAL
NEEDS

We look here at the technical and operating requirements of typical incineration, gasification, pyrolysis and rdf plants and show some of the technology providers.

5.2 MSW WTE THERMAL TREATMENT AND PRE-TREATMENT TECHNOLOGIES

The table below provides a basic summary of the commercial, operational and technology supplier elements of the technologies available.

Assessment Criteria	INCINERATION	GASIFICATION	PYROLYSIS	RDF
Technical summary	Thermal breakdown of waste in an excess of oxygen/air	Thermal breakdown of waste in a depleted oxygen/air environment	Thermal breakdown of waste in the absence of oxygen	Processing of high CV waste (reduced moisture/size) to provide consistent quality fuel
Commercial MSW plants?	Y	Y	N (Pilot)	Y
Years of commercial use	125	10	30	10
Number of global plants	> 1,000	< 150	< 10	< 50 (est)
Locations of plants	Europe, N. America, Singapore	Japan, Europe, N. America	Europe (Non MSW)	Europe, Japan
Pre-treatment of MSW?	N	Y	Y	Y
Thermal efficiency (%)	18-28	12-18	TBC	Depends on WtE option
Process products	Heat and flue gas	Synthesis gas (syngas)	Syngas, pyrolysis oil	Depends on WtE option
Waste reduction potential	80 %	80-90 %	80-90 %	75 %
Process residues	Ash, metal & APC residues	Ash & APC residues	Char, ash & APC residues	Depends on WtE option
ECMs required	Y	Y	Y	Y
Other operational issues	Lower risk of component failure	Higher risk of component failure; syngas needs to be cleaned	Higher risk of component failure; syngas needs to be cleaned	Depends on WtE option
Example technology providers (please see references 1 and 7) at the end of the chapter	GRATE - Babcock Wilcox-Volund, Detroit Stoker, Doosan Lentjes, Fisia Babcock, Hitachi Zosen Inova, JFE, Kawasaki HE, Keppel Seghers, Martin GmbH, Mitsubishi HE, Taikuma, Termomeccanica, Vinci Environment FLUID BED - Doosan Lentjes, EPI, IHI/IKE, Metso, Wheelabrator	ETAG Production, Metso, JFE, Refgas, ETAG, KBI HTCW, vdPas, Biossence, Enerkem, Nippon Steel, vdPas Waste & Energy, WTE Advantage, WES Waste & Energy, Thermoselect, Chinook	IES, Ethos Energy, D4 Energy, Mitsui, SERPAC, TPF-Basse Sambre, Gipec, Toshiba, PKA, WasteGen, Hitachi Zosen Inova, Chinook	Depends on WtE option

Table 5.1: *The commercial, operational and technology supplier elements associated with various WtE technologies*

All the technology options considered here share some common requirements in terms of the expertise needed to design, build and operate them, including maintenance, MSW collection and handling, residues, ECMs, feedstock and supplementary fuels.

Whilst all the technology options covered in this document have their differences, they do share some common requirements that will need to be considered as part of your overall feasibility and planning work:

- all options require a level of expertise for construction, operation and maintenance;
- all options require access to replacement parts for planned/unplanned maintenance;
- to reduce MSW transportation costs, all options should be located as close as practicable to the main sources(s) of MSW;
- your MSW collection/handling systems need to tie in with the ultimate waste treatment option – for incineration/mass burn very little pre-sorting/segregation of waste is required but for the other WtE options you need to plan whether the required pre-sorting of waste is carried out at source or via material recovery facilities (MRFs) etc.;
- all options produce some residues that need to be landfilled – you cannot make plans that do not include some element of landfill disposal capacity;
- all options require environmental control measures (ECMs) to minimise impacts to human health and/or the environment – if the ECMs are not properly managed and maintained, then the lifetime of the WtE plant will be reduced;
- all options require some degree of guarantee of feedstock quantity and/or quality – any WtE plant only represents part of an integrated MSW system; WtE will not be the solution to all your MSW problems.
- all options require some form of supplementary fuel (oil, gas, coal etc.) source to either start the process, or run and maintain critical operating temperatures.

We look at the four technology options in more detail below.

Incineration

Incineration, or 'mass-burn' is the common term given to the direct thermal conversion of MSW via combustion in an environment with an excess of oxygen, at temperatures typically exceeding 850 ^{0}C.

In the early days of msw incineration, the primary objective was simply to reduce the volume of waste that required ultimate disposal. Nowadays, msw incineration processes and technology focus far more on the recovery of heat and energy from combustion and on ensuring environmental emissions are minimised.

There are thousands of operational MSW incineration plants worldwide and most employ moving grate technology, whereby unsorted/treated MSW is transported slowly through the incineration chamber from inlet to outlet on a grate with the primary air required for combustion being fed from below. Fluidised bed technology is also available for MSW incineration, although it is only in Japan where the technology has been used on a commercial scale for MSW. Fluidised bed incineration normally requires some form of pre-sorting and processing to reduce the particle size of the MSW, which is then transformed into a liquid-like state through contact with an upward flow of gas (typically air).

The Lakeside WtE incineration plant near London (UK) commenced operation in 2010 as a JV between Viridor and Grundon.

Its cost is an estimated US$ 245M and has a capacity of 410,000 tonnes per annum (tpa).

Estimated annual outputs are 250,000 MWh of electricity to the national grid, 20,000 tpa in scrap metal, 100,000 tpa of bottom ash and 10,000 tpa of air pollution control (APC) residues.

Figure 5.2: *The Lakeside WtE incineration plant, London*

For both technologies, MSW is converted into hot gases, which are in turn used to heat water in a boiler to produce steam. Steam can be distributed for sale (typically to industrial/chemical manufacturing) or can be converted to electricity through steam driven turbines. There are often discrepancies between manufacturer/supplier quoted efficiencies and what can be independently verified, but in the UK efficiencies are in the range 18 % - 27 % (when generating electricity alone) for plant sizes typically ranging from 25,000 to 600,000 tpa. Both technologies also produce waste residues in the form of bottom/bed ash, boiler ash and fly ash, and scrubber residues from flue gas cleaning operations.

Moving grate incineration is a basic technology which could be easily adopted in Indonesia.

Moving grate incineration is a proven and robust technology for MSW combustion and is therefore more capable of being adopted in Indonesia. The technology itself is quite basic, whilst the main complexities come in the associated optimisation of heat and energy recovery and the minimisation of environmental emissions from incineration.

Unsorted MSW can be fed directly into incineration plants without the need for pre-sorting/processing. Whilst the high moisture content of Indonesian waste will reduce the thermal efficiency (compared to what is achievable in Europe), there is no need for any form of waste segregation and/or treatment, as required by the other options discussed below.

Incinerator operation must be maintained within the critical operating temperatures. Below this, toxic volatile organic compounds (VOCs) harmful to human health and the environment are not properly broken down and the plant gas emissions will breach national safety standards. In order to achieve and maintain safe minimum operating temperatures, where the waste stream volume may be low and/or have a high moisture content, supplementary fuel (usually oil) may be required. This can easily turn a seemingly low-cost efficient method of waste treatment into a very expensive undertaking, and as such must be given careful consideration during project planning.

The need to use supplementary fuels may negate the relatively low-cost incineration option.

Even in properly run plants incinerator flue gas needs careful treatment with gas cooling systems and scrubbers to remove harmful carcinogenic dioxins. The flue gas treatment system is costly to run and requires careful operation and maintenance. Both need to be considered when planning a project in Indonesia.

Gasification

Whilst there are many forms of gasification-based WtE technologies, waste typically requires some form of pre-treatment to produce a consistent (shape and size) feedstock, which normally involves the removal of glass, metals and rubble. The feedstock is then converted in a partial oxidation process (i.e. in the presence of limited oxygen/air), with typical conversion temperatures of 900-1,100 ^{0}C in the presence of air and 1,000 - 1,400 ^{0}C in the presence of oxygen.

It should be noted that syngas may need to be cleaned before it can be used in a gas engine, as it typically contains small quantities of tar and other chemicals that can damage sensitive gas engines.

The conversion process is relatively efficient, with ~ 80% of the chemical energy in the waste (carbon and hydrogen) being converted to chemical energy in gas. This gas is referred to as syngas (synthesis gas) and can be used in a range of applications, such as providing energy for steam boilers or gas engines and subsequent conversion to heat and/or energy.

Whilst air is more commonly used in the conversion process (as it is far cheaper than using oxygen), it does produce a lower energy syngas than that produced using oxygen gasification – the typical net calorific value (NCV) of syngas being 4-6 MJ/Nm^3 for air gasification and 10-18 MJ/Nm^3 for oxygen gasification (as a comparison, natural gas has a typical NCV value of 38 MJ/Nm^3).

The Shin-Moji WtE gasification plant in Kitakyushu City, Fukuoka, Japan commenced operation in 2007 and is operated by Nippon Steel.

It has an estimated capacity of 216,000 tpa with waste disposal to land limited to APC residues only (0.85 % of waste input). All ash and metals are collected and recycled.

***Figure 5.3**: The Shin-Moji WtE gasification plant in Kitakyushu City, Fukuoka*

Gasification is a commercially available WtE technology. There are operational plants all over the world but most are found in Japan where the technology was developed and from where all the leading suppliers originate. There are no working plants in Indonesia to-date. These plants are based on slagging gasification technology and in 2013 WSP estimated that there were 122 operational MSW/RDF plants in Japan which are processing 6,915,870 tpa, with another nine plants reported to be under construction with a combined projected capacity of 1,047,300 tpa. International Solid Waste Association (ISWA) (Ref 7) suggests that technologies such as gasification may be commercially viable in Japan because energy efficiency is typically not a major driver in the choice of WtE technology there (the main priority is the reduction of waste to land) and the treatment price/gate price is much higher than elsewhere. These are examples of the factors the need to be considered when assessing data provided by foreign manufacturers and its applicability to the Indonesian operating environment.

While gasification meets Japan's objectives by reducing the amount of land given over to depositing waste, what is viable overseas may not be viable in Indonesia.

In the UK there are operational plants with capacities typically ranging from 30,000 to 60,000 tpa (although a 250,000 tpa plant is also being planned there) – lower than the normal values for incineration plants.

Plasma gasification is a newer technology for MSW but is less proven on a commercial scale – pilot plants exist with typical capacities of < 10,000 tpa. Plasma gasification is not available in Indonesia yet and should not be considered until proven working plants are successfully operating at a commercial scale in other countries.

Pyrolysis

Pyrolysis involves the thermal degradation of MSW in an oxygen free environment. As with gasification, MSW pyrolysis plants would likely require some form of pre-treatment to produce a consistent feedstock (removal of glass, metals, rubble etc.), but the global, commercial-scale gasification of MSW is currently limited. Pyrolysis plants require an external heat source and for the combustion temperature to be maintained at 400-850 0C; they produce syngas, pyrolysis oil (both fuels), a solid reside (char) and bottom ash/metal residues.

While technically an option, pyrolysis is unlikely to be adopted in Indonesia at present as MSW pyrolysis plants are very rare, except on a pilot scale.

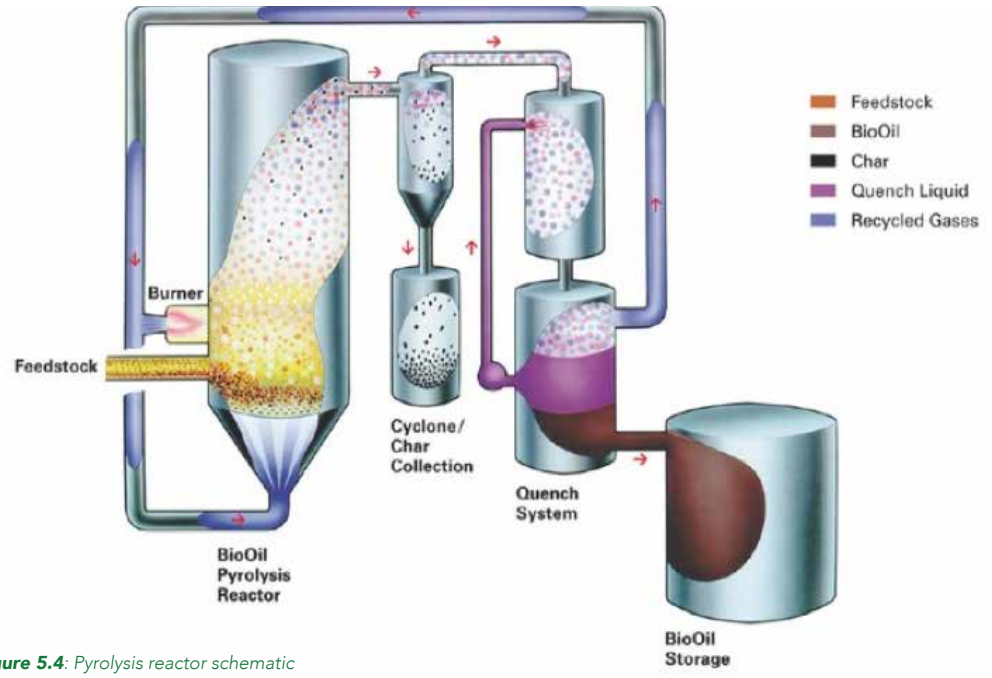


***Figure 5.4**: Pyrolysis reactor schematic*

All products will be produced regardless of the operational temperature, but if pyrolysis is conducted above 800 0C, the primary product will be syngas, whereas at lower temperatures, pyrolysis oil will be predominant – see figure 5.5. Pyrolysis syngas from MSW has been estimated to have an NCV of 10-20 MJ/Nm^3.

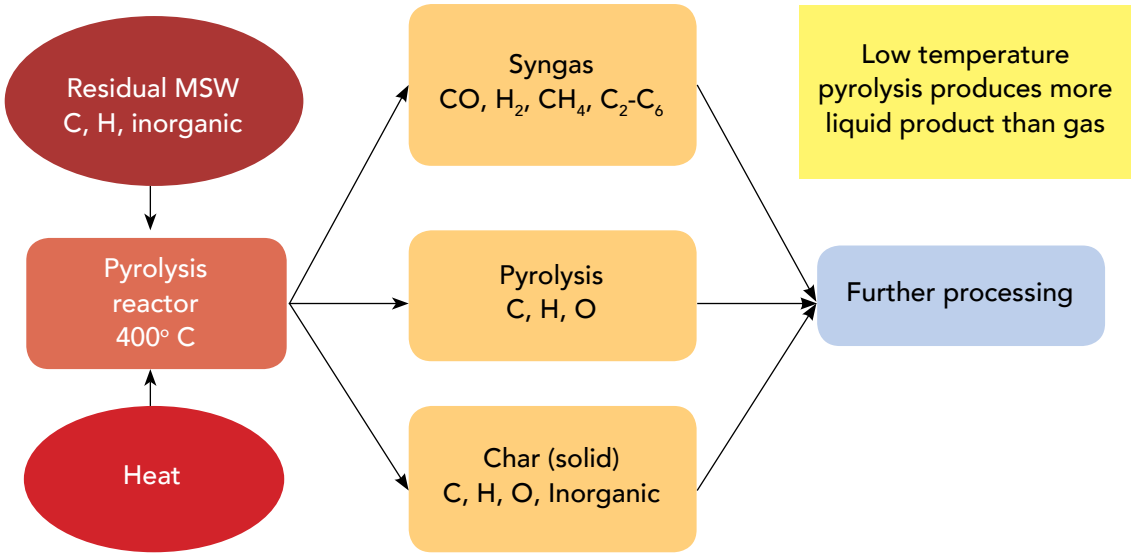


Figure 5.5: *A schematic showing a typical low-temperature pyrolysis process flow*

Low-temperature pyrolysis produces oil rather than gas.

The use of syngas is subject to restrictions similar to those summarised above for gasification – hence, it is likely to require some treatment/cleaning before it can be widely used without damaging power production equipment.

Operational pyrolysis tends to be at a pilot scale unless the systems are designed to treat specific portions of the MSW stream, such as plastics or wood. First Power/First London Power operate a 30,000 tpa mixed waste/wood rotary kiln pyrolysis plant in Cambridgeshire, UK , and SITA/Cynar (Bristol, UK) are developing a pyrolysis-based treatment system that will convert end of life plastics into diesel, kerosene and gasoline grade fuel products. As such, pyrolysis is not really a viable, proven technology that can be adopted for use in Indonesia at this time.

Refuse-Derived Fuel (RDF)

RDF is a method of waste preparation designed to optimise the WtE process.

Refuse-Derived Fuel (RDF) is a fuel or 'feedstock' created as the result of processing and/or treatment of MSW to produce a fuel/feedstock that has a consistent quality. Typically, waste is sorted to focus on the combustible (high NCV) portions of MSW (plastics, biodegradable waste etc.), which is then dried and shredded to increase the NCV. RDF can be utilised in any of the thermal treatment plants summarised above, so it is not in itself a unique WtE methodology, rather a method of waste preparation, which aims to optimise WtE recovery.

RDF production plants tend to be constructed near a high-volume source of MSW and can be linked to a local/adjacent WtE plant. Alternatively, the fuel may be transported for sale to local/regional or even international combustion plants, including WtE plants, cement kilns and coal fired power stations.

The processing of MSW to produce RDF provides a consistent quality of product that helps to ensure that combustion plants operate with a defined product and more predictable NCV properties. However, all the sorting/processing of waste comes at a cost. Some studies have suggested that RDF combustion has no net economic benefits over mass-burn options, as the cost of producing the RDF outweighs the benefits of combusting a more consistent/ reliable MSW product. Markets for RDF in Indonesia are typically focussed on the cement industry with Hocim being one potential consumer, which has shown an interest in RDF.

In Indonesia, the typically high moisture content of MSW (> 45 %) means that the cost of drying it to a desirable rdf moisture level (< 20 %) is much higher than for European countries, where RDF production and utilisation is relatively widespread.

5.3 FURTHER READING

There is a large body of reference materials available covering WtE technologies. The following, non-exhaustive list is intended to provide some key, publically available references that can help to increase reader awareness and knowledge.

Reference number (as quoted in the chapter)	Reference
1	WSP Review of State of the Art Waste to Energy Technologies 2013
2	WSP Investigation into the Performance (Environmental & Health) of Waste to Energy Technologies Internationally 2013
3	DEFRA UK Energy from Waste - A Guide to the Debate 2014
4	DEFRA UK Incineration of MSW 2013
5	DEFRA UK Advanced Thermal Treatment of MSW 2013
6	A Comparative Assessment of Commercial Technologies for Conversion of Solid Waste to Energy
7	ISWA White Paper on Alternative Waste Conversion Technologies 2013

Table 5.2: *Internet references covering WtE technologies*

Chapter Checklist	✔
Now that you have read this chapter:	
Are you familiar with the WtE technologies available globally?	
Do you know what factors should influence your choice of technology?	
Do the technologies and systems you are being offered by suppliers really meet your requirements?	
Do you understand the advantages and disadvantages of the various thermal treatment methods?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 6

PRE-FEASIBILITY AND FEASIBILITY STUDIES

WHAT THIS CHAPTER IS ABOUT

In this chapter we look at the vital role the pre-feasibility study plays in the scoping, planning and development of a public private partnership (PPP) project.

We explain the pre-feasibility process and go through its key stages, including baseline and site investigations.

We show how the pre-feasibility study provides the basis for the full feasibility study and how this in turn is the precursor to the design and tender stage.

THE KEY POINTS

- What pre-feasibility and feasibility studies should cover. *page 90*
- The survey and site data required for feeding into these studies. *page 92*
- The cost of pre-feasibility and feasibility studies cost and who should carry them out. *page 93*

6.1 THE PRE-FEASIBILITY STUDY

The requirements for pre-feasibility studies in Indonesia are set out in the Regulation of State Minister for National Development Planning 3/2012, concerning general guidelines for the implementation of cooperation between the government and business entities in infrastructure provision.

The Pre-Feasibility Study (pre-FS) is an important first step for both local government and project partners to define the project and determine whether it is a viable investment opportunity. Pre-FS outputs include preliminary technical, financial, environmental and social project assessments to a level of detail sufficient to write the Terms of Reference for the feasibility study.

Particularly relevant to projects being carried out under PPP schemes, the pre-FS is intended to identify and inform all parties of the potential benefits, risks and project options.

As a minimum, the pre-FS report should provide the following information and analysis under the headings shown below:

Pre-feasibility studies define the project scope and boundaries, identify risks and benefits, identify options and determine if there is sufficient potential in a project to warrant investing precious resources and moving forward to the next stage.

The Executive Summary

The Executive Summary provides an outline of the pre-FS, from the introduction to the final chapter, setting out the background to the project, including its purpose, scope of work, project feasibility, type of cooperation, institutional arrangements, the regulatory context and environmental matters.

The Introduction

The Introduction covers:

- the background to the project, including its objectives and the reason for its implementation;
- the project's purpose, explaining its aims as well as its expected benefits and outputs; and
- the project physical location, boundary and scope.

Pre-feasibility studies define the project scope and boundaries, identify risks and benefits, identify options and determine if there is sufficient potential in the project to warrant investing precious resources and moving forward to the next stage.

The Legal and Institutional Analysis

The purpose of the legal analysis is to define the institutional arrangements, identify the authorised parties, determine the roles and responsibilities of the Government Contracting Agency (GCA) and project partner(s), and ascertain what licensing is required. In addition, this analysis is intended to ensure that the PPP project is being implemented in accordance with current laws and regulations, including matters concerning legal risk and strategies to mitigate it, and the potential to revise and issue rules and regulations. The legal and institutional analysis includes:

- an examination of all relevant laws, rules and regulations, including detailed explanations;
- an analysis of the institutional background, including organisational structures, job descriptions and human resources; and
- proposals recommending the institutional form to be adopted.

The Technical Study

The Technical Study should include the following information:

In addition to considering the legal and institution background to the project, the pre-FS is a vital early test of the project's technical viability.

- waste projection and waste arising surveys and other specific surveys (where necessary) to demonstrate demand and supply scenarios in the period covered by the PPP, including sensitivity tests;
- the development of options and concept designs, including, amongst others, the carrying out of basic technical surveys for cost estimation, lay out system planning, system components and system capacity;
- land (acquisition) and spatial planning;
- initial environmental and social impact assessments;
- scoping of the PPP project and project outcomes;
- project options, conclusions and recommendations.

The Financial Pre-Feasibility Study

The financial pre-feasibility study provides the basis for a feasible/not feasible (go/no go) recommendation.

The purpose of the Financial Study is to ensure the project's economic viability and to develop an outline business case, including broad-scale financial models for both capital and operating expenditure (CAPEX/OPEX), which can be used to target donors/investors. It is also used to measure and optimise the benefits to be gained from funding the cooperation project (i.e. ensuring best value for money). The financial feasibility study also covers socio-economic cost-benefit analysis, market analysis, financial analysis, and risk analysis. Specifically, the elements included are:

- socio-economic cost-benefit analysis;
- market analysis, including supply and demand analysis, market opportunities and collection of data concerning private interests;
- financial analysis, providing a calculation of financial feasibility that includes financial modelling, CAPEX/OPEX, Internal Rate of Return (IRR), net present value (NPV), payback period, financial assumptions and other necessary financial analysis;
- risk analysis, identification, management and mitigation;
- tariff structure analysis to formulate and calculate the tariffs needed;
- a conclusion, summarising the project's feasibility.

The environmental and social assessment sets out any 'red flag' issues which could potentially halt the project.

The Environmental and Social Assessment

The Environmental and Social Assessment provides an initial environmental examination (IEE). It identifies potential environmental and social impacts, their scale and what mitigation measures are available. Specifically, the environmental and social assessment includes:

- evaluation of the existing baseline environmental conditions and an identification of potential impacts;
- social analysis, including community perception and responses to the project, community social conditions;
- land acquisition and resettlement plans, including the size and location of the land in question, and procurement/compensation requirements;
- environmental monitoring and management plan; and
- a conclusion, summarising the results of the environmental and social assessment, and recommendations for the next steps.

Analysis of the Type of Cooperation

Feasibility studies are based on detailed site investigations and assessments of environmental and social impact. They define order-of-magnitude costs, allow preparation of preliminary plans, layouts, and technical details, and determine O&M requirements.

The type of cooperation being used to develop and deliver the project should reflect how risk is being allocated and identify the parties responsible for financial and asset management. In addition, it should include a summary comparison of each type of cooperation, as well as recommendations concerning each type and the best alternative.

Government Support and/or Government Guarantee

Government support is provided to improve the financial viability of the PPP project. Such support may take the form of a fiscal contribution (grants/tipping fees) and/or be non-fiscal in nature, such as licensing, land acquisition, partial support for construction. It must be stressed that not all businesses involved in PPP schemes are able to gain a reasonable rate of return (i.e. recovering their costs or achieving financial viability). Thus, government support may be required to improve financial feasibility. In addition, the government can also provide support in the form of government guarantees that are intended to reduce business risk in the implementation of the cooperation project.

If the project requires government support, the pre-FS needs to justify why such government support is necessary. The pre-FS document should also define the type and level of support needed and set out the process for obtaining such support. Similarly, if the cooperation project requires a government guarantee, the pre-FS document should explain the need for the guarantee.

Conclusions and Recommendations

This section presents the overall conclusions of the pre-FS for the proposed project. It sets out options and recommendations concerning the project's viability and details the requirements for the follow-up Feasibility Study.

6.2 STAGES IN SURVEYING AND TESTING FOR LANDFILL GAS

The surveys and models used to establish the potential for gas generation described here are covered in greater detail in chapter 4.

Pre-feasibility studies will largely rely on existing baseline data. They will involve limited studies and site investigations and will provide detailed recommendations for survey and site investigation work to be carried out later under the feasibility and design phases. Pre-FS and site investigations may be required where pre-existing data are absent, and without which it would be impossible to determine the project baseline conditions, develop project concepts and options, and build the case for the project. Studies may include:

- initial site condition surveys, including photo and global positioning system (GPS) tracks and site descriptions (topographic and geotechnical surveys are more suited to feasibility studies);
- estimation of the in-situ waste mass and daily waste generation;
- interviews with project stakeholders and local community groups;
- gathering of baseline environmental and climatic data;
- review of waste collection and waste arising data; and
- review of project background data

In addition, the project developer or potential investor will need to understand the potential for gas generation and the nature of the gas. There are a number of basic surveys and models available to establish this potential and we look briefly at them here; they are essential at the pre-FS, planning and design phases to determine gas yield over the project's life.

Measurement of Gas Generation

The gas from the landfill can be measured using the gas generation test or Uji Timbulan Gas. The test is needed to understand the amount and type of gas generated from the landfill. The results of the survey are used in the pre-FS to estimate and analyse the amount of gas that could be utilised in power generation.

The cost of a pre-fs for a waste to energy project in Indonesia may run to usd 250,000, depending on who carries it out and the scope of the project itself.

Measurement of Gas Composition

Suction sampling and testing of gas pilot well samples are used to identify landfill gas composition. These measurements identify the composition of the landfill gas, in particular the levels of methane gas (CH_4), CO_2, O_2, N and other elements occurring in small quantities, such as sulphur, hydrogen and water vapour.

6.3 ESTIMATE COSTING AND FINANCIAL RESOURCES

As mentioned above, pre-FSs for waste to energy projects and the associated survey tests involve review and analysis of all technical, social, environmental and financial/economic matters. This means that the carrying out of these studies requires significant resources. In Indonesia, it is general practice for the pre-FS to be conducted by a group of professional consultants or university students. Overall, the cost of the pre-FS depends on the size of the project(s) and the scope of works, including field operations and the qualifications of the individuals involved. Some project owners or initiators also require the study to take account of international best practice and involve international experts, particularly where donors or international financiers are involved.

The cost of conducting a pre-FS in Indonesia will vary according to project size and complexity. The cost of a local government pre-FS ranges from around USD 50,000 to USD 250,000, depending on the size of area to be scoped for waste management services. In big cities, such as Jakarta, Bandung, Surabaya and Medan, the cost of pre-FSs ranges from USD 150,000 to USD 250,000.

The funding to finance pre-FSs may come from various sources. Generally speaking, pre-FS activities are financed by line ministries, such as BAPPENAS and the Ministry of Public Works, either from the state budget or through grants and loans from international development agencies. The pre-FS may also be funded by the private sector group wishing to establish the project.

6.4 FEASIBILITY STUDY COMPONENTS

Design and tendering follow the pre-FS and feasibility studies and are described in chapter 9.

Following completion of the pre-FS, assuming the outcome is a recommendation to proceed with the project, the next stage will be to undertake a feasibility study. This will build upon the results of the pre-FS, developing the selected project option to a point where it can be taken to detailed design. This will involve detailed site investigations, financial modelling and concept designs. Key components of the feasibility study include:

- project background, baseline, objectives;
- institutional and regulatory frameworks;
- concept technical designs;
- financial and economic analysis;
- detailed environmental and social impact assessments;
- land acquisition and resettlement planning;
- implementation of operation and monitoring (O&M) arrangements
- risks and mitigation measures; and
- terms of reference for the detailed engineering designs.

If both pre-FS and full feasibility studies indicate that the project is viable, likely to attract investment and meets all operational, environmental, health and safety and social requirements, it can then move into the design and tender stage, in which the detailed design, technical and financial documentation required to bid, contract and build the project is completed.

Chapter Checklist	✔
Now that you have read this chapter:	
Have you commissioned or carried out a pre-feasibility study?	
Do you need financial support to undertake or commission a pre-feasibility study?	
Are adequately qualified and experienced persons carrying out your pre-feasibility study?	
Does your pre-feasibility study cover all the relevant areas?	
Are the baseline data sufficient and accurate?	
Do you have the information needed in order to take a decision on whether to proceed with the project?	

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CHAPTER 7

THE INVESTMENT AND LEGAL BASIS FOR WASTE TO ENERGY

WHAT THIS CHAPTER IS ABOUT

In this chapter we look at the amount of investment required for waste to energy (WtE) projects.

We set out the main investment vehicles available for WtE projects, explaining full public finance, business to business and public private partnership (PPP).

We consider the regulations governing the waste and energy sectors, legislation from other sectors that affects WtE projects, and relevant regional regulations.

We describe the regulatory framework governing PPP projects in Indonesia.

We examine what government support is available for WtE projects, including government guarantees.

THE KEY POINTS

- What forms of investment are available for WtE projects in Indonesia. *page 96*
- What laws and regulations govern or affect WtE projects in Indonesia. *page 98*
- What laws and regulations govern the setting up of PPP mechanisms in Indonesia, with specific reference to WtE projects. *page 111*
- What government support is available for WtE projects in Indonesia and how to access it. *page 117*

7.1 INVESTMENT SCHEMES

Infrastructure development is heavily regulated in Indonesia. Potential developers of WtE projects need to have a comprehensive understanding of all the relevant pieces of legislation

Anticipating the increased demand for reliable infrastructure to improve public services and accelerate economic growth, the Government of Indonesia (GoI) has introduced regulatory changes covering the financing of infrastructure projects. Three types of arrangement are recognised: full public finance, business to business and public private partnership. We look at each of these below.

Full Public Finance

Recognising the need to improve the country's infrasturcture, the GoI has legislated to facilitate the financing required.

The fiscal funding used by local government to finance development projects can be generated from various sources, such as local income (pendapatan asli daerah), balancing funds (dana perimbangan), which include special and general allocation funds, as well as specific autonomous funding, loans, taxes and other forms of special transfer funds provided by central government. Under balancing funds, certain provinces may be allocated revenue from a shared fund (dana bagi hasil - DBH) generated from the exploitation of natural resources, such as oil, gas and minerals.

The starting point for provincial budgeting is the Regional Working Unit (Satuan Kerja Perangkat Daerah) or Dinas/Badan. The unit proposes the annual work programme and the accompanying budget for the next fiscal year to the Provincial Development Planning Agency, these documents forming the basis of the regional budget plan. The regional government must submit the regional budget plan to the relevant local parliament in the October before the fiscal year in question. If approved, the local parliament must pass a resolution accepting the budget no later than one month before the start of the next fiscal year. In the event the local parliament does not approve the budget plan, then the previous regional budget remains in force.

The responsibility to manage waste lies with regional government.

Waste Law 18/2008 mandates local governments to allocate funds to manage waste. In other words, local or provincial budgets have to be allocated to waste management activities, which may include the WtE sector. The following table shows the indicative budgets needed to build and operate WtE plants.

Municipal	Average allocation of regional budget	Required investment for processing technology	Estimates of required tipping fee
Solo (265 tpd)	IDR 6 billion/year	IDR 417 billion (incinerator)	IDR 42 billion/year
Bandung (1.850 tpd)	IDR 67 billion/year	IDR 1.650 billion (incinerator)	IDR 185 billion/year
Batam (1.000 tpd)	idr 30-40 billion/year	IDR 1.500 billion (incinerator)	IDR 80 billion/year

***Table 7.1**: Required investment for WtE projects*[1]

Looking at the example of the WtE projects above, it is clear here that public finance alone will not be sufficient and that private investment or financing will be required to realise the project. The two basic forms of private sector participation in WtE projects, Business to Business (B to B) and Public Private Partnership (PPP), are described below.

Business to Business

This is basically an arrangement between business entities, which, in the case of WtE projects, agree the terms and conditions for managing the waste, transforming it into energy and off-taking electricity. While the business entities are able to develop their own WtE plant without the need for state/regional assets, they still require the relevant permits to construct and operate the plant. The business entities themselves may use the electricity produced by the WtE process or sell it to another party, such as the state-owned power generating company (PLN). If PLN takes the electricity from a WtE plant with a solid waste feed, the feed-in tariff is determined in accordance with MEMR 44/2015 (we look more closely at the feed-in tariff in the next chapter of this guidebook).

The main two vehicles for private sector participation in WtE projects are business to business and public private partnerships.

Public Private Partnership

Under the terms of Presidential Regulation No.38/2015 covering PPP (PR 38/2015), PPP refers to cooperation between government and private entities to provide public infrastructure in accordance with specifications determined by the minister/head of government institution/ head of local government/state- or regionally-owned enterprise, which is fully- or partly-funded by the private entity on the basis of risk sharing across all parties.

Based on this definition of PPP, a PPP project is governed by a long-term cooperation agreement, under which a private entity is responsible for managing and funding the project. PPP provides the vehicle required for the financing needs of an infrastructure project to be met from private funds, improving the quality of public services through open competition, increasing the quality of infrastructure management and maintenance and promoting the 'user pays' principle, in certain cases taking the customer's ability to pay into account.

The regulations covering WtE projects operated under a PPP mechanism are still relatively new in Indonesia and to some extent are still being refined. Potential investors and operators should ensure they keep abreast of changing legislation.

The background legal and regulatory framework is crucial for PPP projects. In Indonesia the regulations covering WtE projects under PPP mechanisms are seen as a new model of cooperation and still face some challenges. For this reason, in this guidebook we will concentrate on the legal and regulatory environment for WtE projects under PPP mechanisms and look at a number of fundamental provisions that need to be taken into account when going down this route.

[1] *Bastari Pandji Indra, Implementasi dan Tantangan KPS Dalam Pengembangan Waste to Energy, Bimbingan Teknis PPP Waste to Energy, Hotel Aston, Bogor, 24 September 2014*

7.2 SECTOR REGULATIONS

Separate rafts of legislation govern waste management and the energy sector. We look in detail here at the relevant provisions of these laws and regulations.

Waste management activities in Indonesia are governed by Law No 18 Year 2008 concerning Waste Management (Law 18/2008), Government Regulation No 81 Year 2012 concerning Household Waste Management (GR 81/2012) and Government Regulation No 50 Year 2007 concerning Regional Cooperation (GR 50/2007). Each of these laws has its own implementing regulations, and together they set out a number of fundamental requirements governing WtE project development in Indonesia.

The energy sector in Indonesia is basically regulated under the following laws and regulations: Law No. 30 Year 2007 concerning Energy (Law 30/2007); Law No. 30 Year 2009 concerning Electricity (Law 30/2009); Government Regulation No. 14 Year 2012 concerning Electricity Business (GR 14/2012); and the Regulation of the Ministry of Energy and Mineral Resources No. 44 Year 2013 concerning Purchase of Electricity by PT. PLN (Persero) from Waste Sources for Power Generation (MEMRR 44/2015).

The owner of any municipal and regional waste management project, including WtE projects, comes under the authority of the regional government, either at municipal or provincial government level.

The provisions within these regulations with relevance to WtE project development are shown below.

Management of Authority

Under Law 18/2008, the authority to manage municipal waste lies with regional government. The waste management activities have to be carried out in accordance with the norms, standards, procedures and criteria set out by the central government. In the case of regional landfills, the waste management authority comes under the authority of the provincial government, as set out in GR 81/2012. However, central government also has its own authorities. Table 7.2 shows the authorities of each national and regional government in waste management activities.

Administrative Area	Authorised Party	Authority
National	Ministry of Environment	▪ Determine policy and national strategy on waste management; ▪ Determine norms, standards, procedures and criteria on waste management; ▪ Facilitate and develop cooperation, partnership and relationships between regions on waste management; ▪ Organise, develop and monitor the performance of regional government on waste management; and ▪ Determine the provision for dispute settlement in the area of waste management.

Administrative Area	Authorised Party	Authority
Province	Governor	■ Determine policy and strategy on waste management, according to the provisions set by central government; ■ Facilitate cooperation, partnership and networking between regions in one province in the area of waste management; ■ Coordinate, develop and supervise regency/city performance in the area of waste management; ■ Facilitate dispute settlement on waste management between regencies/cities in a province.
Regency/city	Regent/mayor	■ Determine the provision of, and strategy on, waste management in accordance with national and provincial policy; ■ Conduct waste management operations at regency/city level based on the norms, standards, procedures and criteria set by central government; ■ Develop and supervise the performance of waste management activities carried out by other parties; ■ Determine the location of temporary shelter, integrated temporary waste-processing sites, and/or final waste-processing sites. ■ Monitor and regularly evaluate (every six months for 20 years) final waste-processing at closed open dump sites; and ■ Prepare and provide an emergency response system for the waste management activities under its own authority.

***Table 7.2**: Distribution of authority for waste management activities*

The Tipping Fee

The Tipping Fee is the amount of compensation paid by the government/regional government to a party to manage municipal/regional waste management activities. In accordance with Law 18/2008, the government and regional government is obliged to finance waste management activities from the state/regional budget, known as the Regional Budget (Anggaran Pendapatan Belanja Daerah or APBD) or State Budget (Anggaran Pendapatan Belanja Negara or APBN).

Some municipalites have had difficulty funding the tipping fee from their budgets and investors should take this into consideration when researching a WtE project.

While law 18/2008 requires the regional government to provide a budget to manage waste, in particular in the form of the tipping fee, experience shows that some municipalities have had difficulty in paying the fee, given the limited budgets at their disposal. Accordingly, careful consideration of the prevailing laws and regulations is required before tipping fees are applied. In the financing section covered later in this chapter we will discuss how to calculate tipping fees, including the aspects to be considered.

Approval of the Regional Parliament

In PPP projects, the regional government, at either provincial or municipal level, may act as the Government Contracting Agency (GCA). This agency may be based on a cooperative arrangement between regional governments, regional government and central government, or between regional government and private entities. However, implementation of this regulation invariably involves the regional parliament as a budgeting agency; accordingly one of the tasks and authorities of the regional parliament is to approve a regional cooperation plan.

A cooperation agreement is required between a regional government and a private entity to operate a PPP scheme.

Such cooperation is regulated under Law No. 23 of 2014 on Regional Government (Law 23/2014) and Government Regulation No.50 Year 2007 concerning Regional Cooperation (GR 50/2007) and must be implemented in accordance with the Regulation of Minister of Home Affairs No.22 Year 2009 concerning Technical Procedures for Regional Cooperation (MOHAR 22/2009).

In accordance with MOHAR 22/2009, a regional government intending to cooperate with a private entity under a PPP scheme may enter into a cooperation agreement (CA) with the private sector party. The CA should cover the following provisions as a minimum:

- the parties to the cooperation;
- the objective of the cooperation;
- the scope of the cooperation;
- the rights and obligations of the contracting parties;
- the duration of the cooperation;
- the termination of the cooperation;
- Force Majeure; and
- dispute resolution.

If a WtE requires a budget allocation for tipping fees, parliamentary approval is needed, unless funding has been set aside in the current year's budget.

When preparing the CA, the head of the regional government may seek advice from independent experts/consultants, staff/experts from the provincial government, and ministers or heads of any government institutions, as required. It should be noted that CAs may also include additional provisions, so long as they do not contravene prevailing laws and regulations.

Under GR 50/2007, if the implementation of a CA requires regional budget approval from the regional parliament, the budget allocation should be approved and allocated in the budget plan (DIPA) for the rolling fiscal year. For WtE projects operated under PPP mechanisms, such approval is strongly linked to tipping fees. Whenever a project of this nature requires budget allocation for tipping fees, parliamentary approval is needed, unless funding has been budgeted in the DIPA.

The procedures required to obtain parliamentary approval under GR 50/2007 are shown in the flowchart below:

***Figure 7.1**: Flowchart showing the parliamentary approval process*

Feedstock

This is the fuel used to produce the electricity and is therefore one of the fundamental aspects of a WtE project. Certain technologies may require continuous, large amounts of waste of a consistent quality and for this reason the feedstock supply to the WtE process must be sufficient in terms of both quality and quantity. The provision of feedstock can be included in the CA in those cases where the government is responsible for supplying sufficient waste to the landfill as the energy resource. GR 81/2012 states that separation, collection, transportation, processing and finalisation of waste are government responsibilities.

Investors should carefully assess the potential quantity and quality of waste as feedstock.

It should be noted that, in the case of a WtE project under a PPP scheme, the role of the municipal government for particular activities, such as collection and transportation of waste, is limited to those carried out by the regional corporation or regional working units (SKPD), which have the primary responsibility for waste management. In the case of separation, processing and finalisation however, these activities may be conducted by the business entity which wins the tender.

It is also important to recognise that other parties are involved in waste management processes, such as collecting and recycling at community level or in industrial zones and that this may lead to reductions in the amount of waste transported to the landfill.

Electricity Production

The output of WtE projects is electricity and, for this reason, private entities involved have to comply with Law 30/2009 and its implementing regulations, since electricity supply is controlled by the government's state-owned company and delivered by central and regional authorities on the principle of regional autonomy. Private business entities, cooperatives and non-government organisations are nevertheless allowed to participate in power production.

As electricity producers, WtE operators require energy supply licences from the Ministry of Energy and Mineral resources or regional/ local government, depending on circumstances.

Some power supply businesses serving the public do, however, require a specific licence, which is valid for 30 years and may be extended. Licences to produce electricity for an entity's own use are valid for 10 years and can also be extended. Such licences are issued by the relevant administrative authority as described in the following table.

Licensing Authority	Requirements
Ministry of Energy and Mineral Resource	▪ the working area is located in the province; ▪ the operation is carried out by the state-owned enterprise; and ▪ the power is sold and/or rented to the holder of the electricity supply licence issued by the relevant ministry.
Governor	▪ the working area is located in a regency/city; and ▪ the power is sold and/or rented to the holder of the electricity supply licence issued by the governor.
Regent/Mayor	▪ the working area includes one regency/city; and ▪ the power is sold and/or rented to the holder of the electricity supply licence issued by the regent/mayor.

***Table 7.3**: Distribution of authority relating to the issuing electricity supply licences*

Offtake and Feed-in Tariff

At time of writing and based on generating 10 MW, the amount of feed-in tariff ranges from IDR 1,250 to IDR 1,798, depending on the type of landfill and the voltage produced.

According to MEMRR 44/2015, the State Power Company (PLN) is obliged to offtake the electricity produced from municipal waste sources. Furthermore, this regulation governs the amount of feed-in tariff as follows:

- based on up to 10 MW using zero waste technology: IDR 1,450 (one thousand four hundred and fifty Rupiah) per kWh (with medium-voltage connection) and IDR 1,798 (one thousand seven hundred and ninety eight Rupiah) per kWh (with low-voltage connection);
- based on up to 10MW using sanitary landfill technology: IDR 1,250 (one thousand two hundred and fifty Rupiah) per kWh (with medium-voltage connection) and IDR 1,598 (one thousand five hundred and ninety eight Rupiah) per kWh (with low-voltage connection).

We illustrate below the procedures and steps required to enter into a power purchase agreement (PPA) between the appointed business entity and PLN.

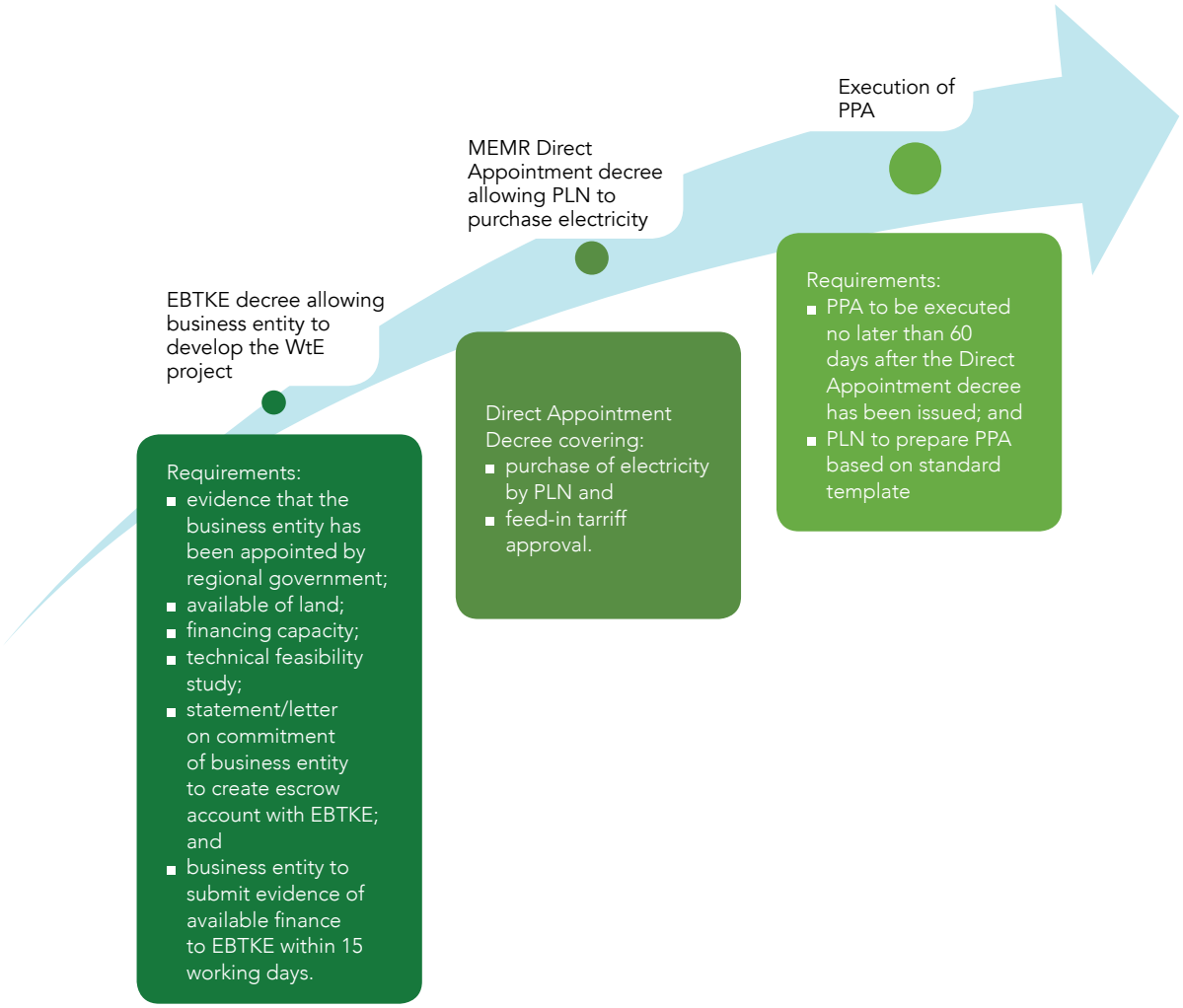


***Figure 7.2**: Procedure for entering into a PPA with PLN*

(EBTKE means Directorate General of New, Renewable Energy and Energy Conservation)

7.3 INTER-SECTORAL REGULATIONS

The legislation relevant to WtE extends beyond the waste and energy sectors and includes land acquistion, health, safety, the environment, as well as busines related matters, such as competition rules .

In addition to the regulatory framework covering the waste and energy sectors, there are also inter-sectoral regulations that need to be taken into account in WtE project development. In this section we highlight some of the relevant issues and discuss some fundamental inter-sectoral questions, including land acquisition, establishment of a special purpose company (SPC), investment, business competition, occupational safety, and construction and environmental safeguards.

Land Acquisition

The acquisition of land must be carried out in accordance with:

- Law 2/2012;
- PR 71/2012 and its multiple amendments under PR 40/2014, PR 99/2014 and PR 30/2015 (PR 71/2012 as amended); and
- National Land Agency (BPN) Regulation 5/2012.

These regulations are known collectively as the Land Acquisition Framework, which provides a basis for compulsory land acquisition for infrastructure projects in the public interest. Development of a WtE project qualifies as an infrastructure project in the public interest, and, accordingly, the framework may be applicable to land acquisition for this type of project. Under the Land Acquisition Framework, the process of land acquisition is divided into three stages: planning, preparation and implementation. The planning stage consists of the preparation of a project feasibility study and a land acquisition plan document. While some preliminary planning documents will be prepared by the GCA, the preparation of the land acquisition plan document and the actual implementation of land acquisition are led by the local government. Among other things, the land acquisition plan document must demonstrate that the acquisition is in line with the existing spatial plan and is in accordance with the list of priority developments set out in the medium-term development plan, the strategic plan and the government agency's work plan.

The land acquisition process must include a public consultation exercise managed by the GCA.

The preparation stage commences after the land acquisition plan has been approved by the GCA, as the entity requiring the land, and then submitted to the governor. The preparation stage consists of, among others, public consultation and determining the location for the development, known as Surat Persetujuan Penetapan Lokasi Pembangunan (SP2LP). Public consultation is organised by the GCA. If the governor is acting as the GCA, he/she must also issue the SP2LP. The governor must set up a preparation team to coordinate the implementation of activities during the preparation stage. Members of the team comprise the head of region (regent/mayor), related regional units (SKPD terkait) and the GCA, as the entity requiring the land, plus other related agencies.

The implementation stage commences after the SP2LP has been issued, and is led by the regional BPN office. The implementation stage consists of, among others, a land status inventory, a land valuation by an independent appraiser appointed by BPN, negotiation of compensation, payment of compensation and transfer of land title.

There are several forms of compensation open to persons or entities affected by land acquisition, including financial, restettlement and share ownership in the WtE project.

Under the Land Acquisition Framework, the form of compensation take the form of payment of money, land in compensation, resettlement and ownership shares in the project or other mutually agreed forms of compensation. The Land Acquisition Framework provides broad criteria for persons eligible for compensation (not only persons owning the land with registered title). These criteria are stipulated in Articles 17 to 26 of PR 71/2012, as amended. The framework provides a mechanism for a challenge by any objecting party. Any objection during public consultation may be submitted directly to the team carrying out the public consultation. Any objection after the SP2LP has been issued may be submitted to the relevant state administrative court (PTUN) within 30 days after the SP2LP has been issued. Any objection to the land status inventory may be submitted to BPN within 14 days after its announcement. Any objection to the result of negotiation of compensation may be submitted to the district court (with right to appeal to the Supreme Court).

Financing for land acquisition by a national governmental body comes from the APBN or APBD. The GCA, which also acts as the local government, must make sure that all land acquisition costs, including compensation costs and any other operational and supporting expenses, are included in the APBD for the relevant year in which the land acquisition is to be implemented. The guidelines for determining the operational and supporting expenses must follow MOHA Regulation 72/2012.

In addition to the above, in the case of a PPP project, private investors are allowed to fund the land acquisition as part of the implementation of the PPP project. The land acquisition cost may be repaid by the GCA to the private investors through APBD or in the form of recalculation of the investment value.

The land acquisition process is described in greater detail in table 7.9 at the end of this chapter.

A particular type of limited company, known as a special purpose company or SPC, is required to implement a WtE project. We show here how to establish such a vehicle.

Establishment of a Special purpose company

Private entities which win bids for implementing WtE projects under PPP mechanisms are required to establish a special purpose company (SPC). Provisions regarding the establishment of business entities, especially in the form of a limited liability companies, are regulated under Law No. 40 of 2007 concerning limited liability companies (Law 40/2007). According to Article 1 Paragraph (1) of this law, limited liability company means a legal entity that constitutes an alliance of capital established pursuant to a contract in order to carry on business activities with an authorised capital, all of which is divided into shares and which fulfils the requirements stipulated in Law 40/2007 and its implementing regulations.

A company must be established by two or more persons on the basis of a notarised deed in the Indonesian language. The Deed of Establishment must properly elaborate all of the

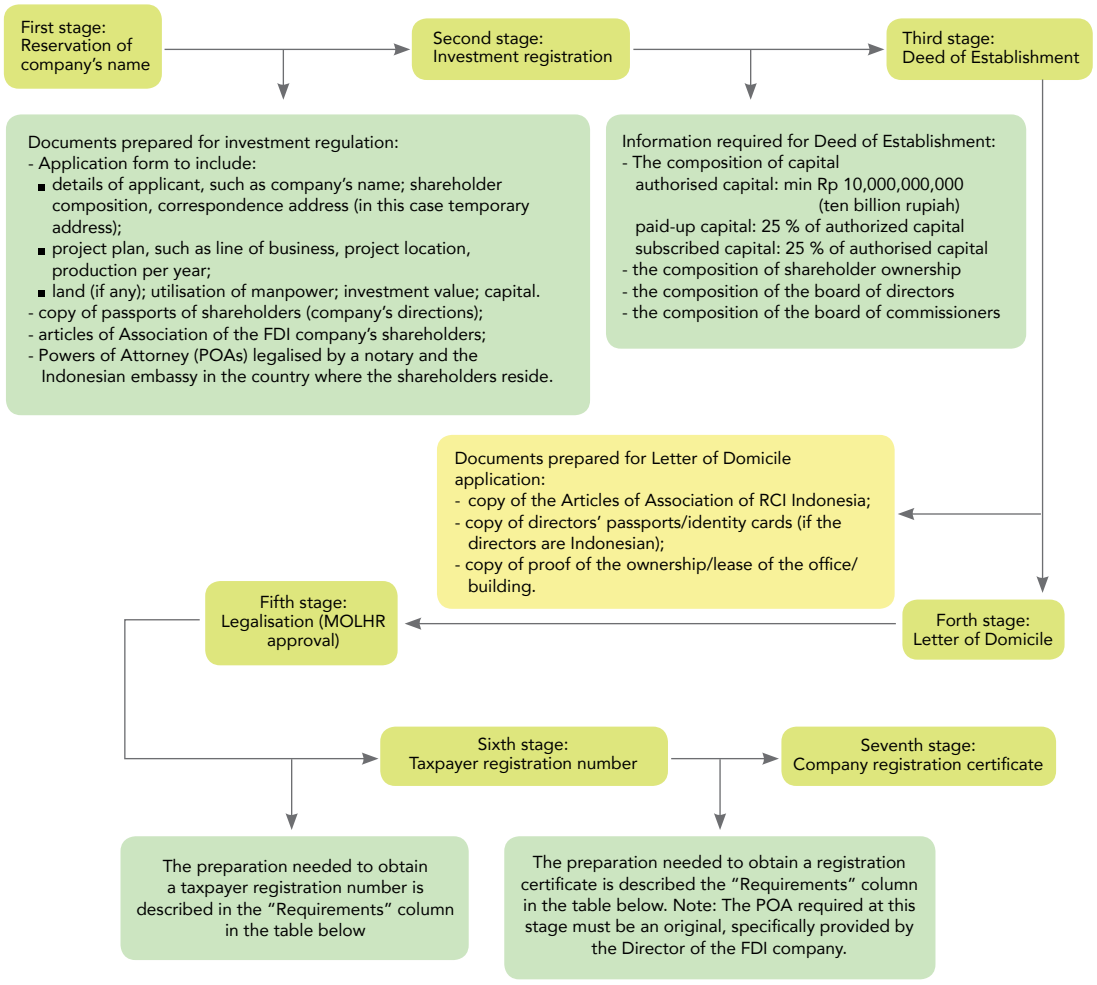


***Figure 7.3**: Procedures for the establishment of an SPC*

company's commercial activities. The founder must hold 25 % of the authorised capital, which should be paid following the approval of the establishment of the legal entity by the Minister of Law and Human Rights. The information required to establish a company is:

- place of domicile;
- tax identification number;
- company registration certificate;
- registration of foreign investment with the Indonesia Investment Coordinating Board, Directorate of Infrastructure Planning (BKPM); and
- provisional licence from BKPM.

The SPC must be established within six months of the date the winner of the tender is selected.

According to BAPPENAS Regulation No. 3 of 2012, an SPC should be established within six months of the date when the winner of the tender is selected. Both the SPC and the GCA must sign the CA. The SPC should be managed by a board of directors, which has a significant role to play as the manager of the project; a board of commissioners should supervise the company's performance. Furthermore, unless stipulated otherwise in the Articles of Association and Law 40/2007, the board of directors may conduct activities in the interests of the company.

Investment

A foreign legal entity seeking to invest in a WtE project in Indonesia must comply with the provisions of Law No 25 of 2007 concerning Investment (Law 25/2007), along with its implementing regulations. Under this legislation, all foreign investors must establish a limited liability company or Perseroan Terbatas (PT). Any PT comprising foreign capital is considered as a foreign investment company (PT PMA).

Foreign investors in a WtE project must establish a limited liability company in Indonesia.

A negative investment list or Daftar Negatif Investasi (DNI) is required to establish a PT PMA.

The DNI contains certain fields of business, in which share ownership by foreign investors is limited or even forbidden. The DNI is set out in Presidential Decree No. 39 of 2014 (PR 39/2014). In the context of WtE, the following are the maximum limits of foreign ownership:

- small-scale electricity producing company (1 MW to 10 MW): up to 49 %;
- electricity company producing more than 10 MW: up to 95 % (in the case of a PPP, foreign ownership may be up to 100 %);
- non-hazardous waste management: up to 95 %.

Foreign investment companies may be entitled to a number of tax incentives.

A foreign investment company may benefit from investment incentives in the form of exemptions from import duty for machines and export duty for certain goods and materials, as well as reduced corporation tax. Furthermore, PR 39/2014 states that to manage and dispose of non-hazardous waste, the maximum ownership for foreign investors is 95 % of the PT PMA.

Every PT PMA is entitled to obtain fair treatment as a domestic company, i.e. obtain legal certainty and protection, information and various reliefs on facilities. In addition, the government may also grant relief on services and licensing, and help in obtaining land rights. Such land rights may take the following forms:

- *right of cultivation* may be granted for 95 years and extended by securing the right in advance for 60 years and renewing for 35 years;

- *right to build* may be granted for 80 years and extended by securing the right in advance for 50 years and renewing for 30 years;
- *right of use* may be granted for 70 years and extended by securing the right in advance for 45 years and renewing for 25 years.

Other investment incentives provided are immigration services facilities; a PT PMA is entitled to employ foreign workers to strengthen its team. However, Law 25/2007 states that, while the PT PMA is entitled to employ foreign labour for certain positions and experts for technology transfer purposes, priority must be given to use of local labour.

Investment licences are granted by the Indonesian Investment Coordinating Board, which offers a one-stop-shop service to potential investors.

Relief on the land rights listed above may be provided, if the investment:

- is a long-term investment and relates to changes in Indonesia's economic structure to increase competitiveness;
- requires a return over a long-term period;
- does not require a large area;
- utilises state assets; and
- does not interfere with justice or harm the public interest.

In the case of investment licensing, the GoI has established an institution with the authority to approve the establishment of an investment company and to provide the necessary licences. This is the Indonesia Investment Coordinating Board, which offers a one-stop-shop service.

Environmental Safeguards

Business licences can only be awarded after an environmental licence has been issued.

Under Law 32/2009, all business activities in Indonesia, which have a significant impact on the environment require an environmental impact assessment (Analisis Mengenai Dampak Lingkungan or AMDAL) and must obtain an environmental licence. The issuing of an environmental licence is a pre-requisite for the issuing of any business licence.

Business and/or activities requiring an AMDAL are further governed by Ministry of Environment Regulation No. 5 of 2012 (ME Reg. 5/2012). Article 2(1) of ME Reg. 5/2012 states that any business and/or activities which significantly affect the environment must have an AMDAL. It should be noted that waste management activities are classified as businesses and/or activities requiring an AMDAL, as stated in Annex I of ME Reg. 5/2012 covering AMDAL in the waste sector. Under this legisation, therefore, the project initiator is required to prepare an AMDAL and an environmental licence.

Table 7.4 below lists the types of waste management requiring AMDAL.

An environmental impact assessment, known in indonesia by the abbreviation AMDAL is required in order to obtain an environmental licence. We look here at the procedures required for an amdal.

Type of Activity	Scale of Activity
Development of domestic landfill with controlled landfill or sanitary landfill technology	▪ requiring land more than 10 hectares; or ▪ waste management capacity more than 100,000 tonnes
Development of integrated waste management installation	▪ waste management capacity more than 500 tonnes per-day
Development of landfill with incinerator technology	▪ all capacity

Table 7.4: *Waste management activities requiring AMDAL*

The procedures and requirements of the AMDAL environmental impact analysis, as regulated under GR 27/2012, are set out in table 7.5 below.

Activity	Time Period
First stage	
The initiator announces the business planning and public consultation (Article 9 (4) GR 27/2012)	10 business days
Step 1	
▪ The initiator prepares the reference framework	
▪ The initiator submits the reference framework to the minister, governor and regent/mayor	
▪ The initiator awaits the assessment on reference framework from assessment commission regarding AMDAL (Article 23 GR 27/2012)	30 business days
▪ The initiator corrects the reference framework according to the feedback from assessment commission concerning AMDAL (Article 25(1)a GR 27/2012)	Maxium of 3 years from the accepted date of document
Step 2	
▪ The initiator prepares AMDAL, the environment management plan and the environment monitoring plan (Rancangan Pengelolaan dan Pengawasan Lingkungan - RKL/RPL)	
▪ The initiator submits AMDAL and RKL/RPL to the minister, governor and regent/mayor	
▪ The initiator awaits the assessment regarding AMDAL and RKL/RPL from the assessment commission (Article 31 GR 27/2012)	75 business days
Step 3	
▪ The initiator awaits the result meeting from AMDAL assessment commission (Article 31 GR 27/2012)	75 business days
▪ The initiator awaits the decision from the minister, governor and regent/mayor (Article 32(2) GR 27/2012)	10 business days since accepted by the result meeting

***Table 7.5**: Procedures for obtaining AMDAL*

Business Competition

WtE project developers should ensure that the project cannot be classified as a monopoly under Indonesian legislation.

Business Competition is regulated under Law 5/1999. Under this law, any activities or agreements, which could potentially bring about centralised control of production and marketing of certain goods or services are prohibited. A natural monopoly may be created with respect to production and marketing of goods and services critical for the life of the people or the nation, provided that such a monopoly is permitted by law, and implemented by a state-owned enterprise or an entity appointed by the government. Under KPPU Decree 89/2009, an entity allowed by the government to monopolise the production and marketing of certain goods and services is not authorised to transfer its right to any third party.

WtE project developers must ensure that the project is not classified as a monopoly. Article 19 of Law No. 5 Year 1999, covering the Prohibition of Monopolistic Practices and Unfair Business Competition, states that business actors are prohibited from engaging in one or more activities, either individually or jointly with other business actors, which may result in monopolistic practices and/or unfair business competition, if their activities:

- reject and/or impede certain other business actors from conducting the same business activities in the relevant market; or
- bar consumers or customers of their competitors from engaging in a business relationship with such business competitors; or
- limit the distribution and/or sales of goods and/or services in the relevant market; or
- engage in discriminatory practices towards certain business actors.

Laws 18/2008 and GR 81/2012 provide for the possibility of a business entity/private entity undertaking waste management. However, the appointment of the business entity must be carried out in accordance with the prevailing laws and regulations.

Construction[2]

Construction services relate to the provision of consultant services for construction work planning, construction work performance and construction work supervision. The parties in construction work consist of a service user and a service provider. Construction services businesses may take the form of individuals or business entities. Construction services business carried out by individuals as the service provider can only carry out low-risk construction work, using simple technology and at low cost; high-risk construction work and/or use of advanced technology and/or at high cost can only be performed by limited liability companies or the equivalent foreign corporations.

Licences for construction services provider

Construction services providers in the form of business entities must comply with business licence provisions in the field of construction services and have the certificates, classifications and qualifications of a construction service company. The holding of a classification and qualification standard is a recognition of the level of proficiency of business entities, both national and foreign, in the field of construction services. Such recognition is obtained through a test(s) carried out by an institution assigned to perform it and then formal registration, involving classification, qualification, and certification. Only certified business entities are permitted to work in the construction services field.

Major construction work can only be carried out by Indonesian limited liability companies or equivalent foreign corporations and must be properly licensed.

Construction services business licences are further governed by Article 14 of Government Regulation Number 28 of 2000 on Business and Society of Construction Services Role (PP 28/2000); Government Regulation Number 4 of 2010 on Amendment of PP 28/2000; and Decree of Minister of Settlement and Regional Infrastructure Number 369/KPTS/M/2001 on Guidelines of Licensing for National Construction Service Business.

Bidding for construction work

Bidding in construction services work is based on the principle of healthy competition in the selection of the service provider through public or limited tender. Under certain conditions, the selection of a service provider may be carried out through direct selection or direct appointment. The selection of the service provider takes account of the provider's fit with the field of business, the balance between capability and workload, and performance. Business entities owned by the same person or a group or in the same management structure cannot be part of the tender for the same piece of construction work. The procedures for selection of service providers are stipulated in Government Regulation Number 29 of 2000 (GR 29/2000) on Construction Services Performance (PP 29/2000) and Government Regulation Number 59 of 2010 (GR 59/2010) concerning the amendment of PP 29/2000.

Contracts for construction services are awarded under competitive tender, but may be granted directly under certain circumstances.

[2] *http://www.hg.org/article.asp?id=20340*

Construction work contracts

The regulation of the working relationship between the service user and the service provider is covered in the construction work contract. This contract should be written in Bahasa; construction work contracts involving foreign parties may be written in Bahasa and English. As a minimum, a construction contract should comprise:

We list here the main components of a typical construction services contract.

- a description of the parties;
- a description of the work;
- liability and/or maintenance period;
- experts;
- rights and obligations;
- terms of payment;
- provisions in the event of default;
- dispute settlement;
- termination of the construction work contract;
- Force Majeure;
- construction failure;
- workers' protection; and
- environmental aspects.

The government has a key role to play in construction through regulation, empowerment and supervision.

Construction work contracts relating to planning works should contain provisions covering intellectual property rights.

The description of the work comprises the scope of the work, the value of the work and the performance time.

The scope of work covers the amount of work to be performed, administrative requirements binding on all parties, the technical provisions that the service provider has to comply with, the liability or guarantee (covering work performance, receipt of down payment and accidents) and the report to be used to record construction progress.

The value of work is the amount of costs to be incurred by the service provider in performing the entire work scope. The performance time limit is the period of time required to complete the entire scope of work, including the maintenance period.

There is an assortment of sanctions to deal with infringements of construction services legislation, ranging from temporary suspension of work to the revocation of business and professional licences.

The government's role in construction

The government also has a role in the performance of construction work and the development of construction services through regulations, empowerment and supervision. The regulating function is carried out by issuing laws, regulations and technical standards. The empowering function supports construction services businesses and society in developing awareness of their rights, obligations and roles in the performance of construction services. The supervisory function monitors the performance of construction works in order to ensure they are undertaken in an orderly manner and comply with prevailing laws and regulations. The society of construction services providers may also play a role in supporting the government's actions in this field, as stipulated in Government Regulation Number 30 of 2000 on Performance of Construction Services Development.

Sanctions

In the event that violations of Construction Services Law take place, the administrative sanctions that may be imposed are: a written warning; temporary termination of construction work; restriction of business activities and/or profession; temporary prohibition on the use of the results of the construction work (limited to the services user); suspension of business and/or professional licence; and revocation of business and/or professional licence. In addition to these administrative sanctions, the person(s) performing the construction work may be subject to a sentence of a maximum five years' imprisonment or a fine of up to a maximum of 10 % of the contract value.

Occupational Safety

The CA should require the waste management business entity to comply with occupational safety requirements in relation to the project. Generally speaking, the occupational safety requirements must comply with Law 1/1970, as supported by several implementing regulations issued by the Ministry of Manpower and Transmigration and the Ministry of Public Works.

7.4 PPP REGULATIONS

Having looked at the regulatory framework and fundamental provisions of the waste and energy sectors and the associated inter-sectoral regulations, we now need to gain an understanding of the regulatory framework governing PPP in order to appreciate how WtE projects can operate under the PPP mechanism. This section will therefore focus on the regulations covering PPP, specifically in the context of WtE projects.

The legislation governing PPPs in Indonesia is complex and wide-ranging. We consider the three key regulations below:

Definition of the term 'PPP'

Before looking in more detail at the legal environment surrounding WtE projects under PPP schemes, we need first to understand the term 'PPP', in order to avoid potential confusion. This is because the term 'PPP' may overlap with other terms which have similar meanings, such as Private Finance Initiative (PFI), Cooperation between Government and Private Entities (Cooperation), Private Participation, Private Sector Investment (PSI) etc. It should also be noted that PPP in Indonesia is governed through a number of regulations.

Delmon (2009) points out that PPP means 'an arrangement between public and private entities for the delivery of infrastructure services but more importantly as a means to extend or leverage budget funding through efficiency gains'. PPP therefore should be seen as any cooperation between government and private entities to carry out public services, including infrastructure, as governed by the prevailing laws and regulations.

The regulations covering PPP

PPP in Indonesia is governed by the following regulations, each addressing different contexts:

- Government Regulation No. 27 Year 2014 concerning Management of State/Regional Assets (GR 27/2014), previously known as Government Regulation No. 06 Year 2006 concerning Management of State/Regional Assets (GR 06/2006);
- Government Regulation No. 50 Year 2007 concerning Regional Cooperation (GR 50/2007);

- Presidential Regulation No. 38 Year 2015 concerning Cooperation between Government and Business Entities in Infrastructure Provision (PR 38/2015), the latter specifically covering PPP for infrastructure projects.[3]

We look at the provisions set out in these regulations below.

GR 27/2014 (Management of State/Regional Assets)

…those covering management of state and regional assets…

In the context of PPP, this regulation addresses the use of state/regional assets by other parties, including private entities. The intention of Article 1 of this regulation is to maximise the utilisation of unused state/regional assets without changing their ownership status. The government may enter into cooperation using the following mechanisms:

…including the key components of the main types of PPP model for management of state assests…

- Rent -Sewa - this means utilisation of state/regional assets by another party on the basis of a rental agreement for a specific period of time and involving payment.
- Lend-use – Pinjam Pakai (PP) - this involves the transfer of government assets between central government and regional government or between regional governments over a specific period of time without payment and with the assets being returned to the asset manager at the end of the period. It should be noted that this mechanism is not an option for cooperation between government and private entities.
- Cooperative utilisation – Kerjasama Pemanfaatan (KSP) - this is the use of state/regional assets by another party for an agreed period of time for the purpose of increasing tax/regional revenue.
- Built Operate Transfer (BOT) or Built Transfer Operate (BTO) - this refers to the use of state assets, under which land is provided for infrastructure and facilities construction by another party over an agreed specific period of time, with the handing over to the state of the construction or facilities after the concession period expires.
- Cooperation for Providing Infrastructure - Kerjasama Penyediaan Infrastruktur (KSPI) - this involves cooperation between the government and a private entity in order to provide public infrastructure in accordance with the prevailing rules and regulations.

The following table illustrates some of the fundamental models for each of these cooperation mechanisms in terms of partner organisation, duration and payment obligation.

Partner organisation	Duration	Payment obligation
Rent mechanism		
Parties other than ministries/government institutions and regional government.	Maximum of 5 years (with the possibility to extend under certain conditions).	Rental tariff
Lend-use (PP) mechanism		
Central government or regional government.	Maximum of 5 years, extendable for one period.	N/A
KSP mechanism		
KSP partner, selected through tender exercise (state-owned enterprises/certain SOEs may be appointed directly without tendering in the case of state-owned/regionally-owned assets).	Maximum of 30 years with the possibility to extend (to a maximum of 50 years, with the possibility to extend in the case of certain infrastructure provisions).	N/A
BOT/BTO mechanism		
BOT/BTO partner, selected through tendering.	Maximum of 30 years, with the possibility to extend.	Fixed contribution
KSPI mechanism		
KSPI partner, appointed in accordance with prevailing laws and regulations.	Maximum of 50 years, with the possibility to extend.	Surplus profit sharing (clawback)

Table 7.6: Summary of cooperation mechanisms under GR 27/2014

[3] *Previously was PR 67/2005 as amended.*

The implementation of GR 27/2014 is supported by the Regulation of Minister of Finance No. 78/PMK.06/2014 concerning Procedures for Utilisation of States Assets (MOFR 78/2014) and the Regulation of Minister of Finance No. 164/PMK.06/2014 concerning Procedures for Utilisation of States Assets in Infrastructure Procurement (MOFR 164/2014).

The following table summarises the PPP provisions governed by regulation GR 27/2014:

PPP provisions regulated under GR 27/2014
Infrastructure sectors open for cooperation
Ports; airports; railways; toll roads; toll bridges; drainage; drinking water processing; waste water processing; waste processing; telecommunications; electricity; oil and gas.
Partnership Object
Limited to utilisation of 'unused state/regional owned assets or regional owned assets'.
Mechanism for procuring business entity/partner
■ rent is not payable during the bidding process; ■ BOT/BTO should be conducted through a bidding process; ■ KSP and KSPI should be conducted through a bidding process
Incentives
Exemption/relief on import duties on imported capital goods; exemption/deferral of Value Added Tax on imported capital goods; amortisation; relief on Land and Building Tax; services and/or licensing facilities to obtain land rights (Right of Cultivation is a maximum of 95 years, Right to Build is a maximum of 80 years, and Right of Use is a maximum 70 years); immigration services facilities; import licensing facilities.

***Table 7.7**: Summary of the fundamental issues of PPP under GR 27/2014*

GR 50/2007 (Regional Cooperation)

The parties involved are regional governments and central government, and regional government and private entities. In the context of cooperation between regional government and private entities or PPPs, this regulation covers all cooperation mechanisms and/or projects for provision of public services. The below table briefly illustrates a number of fundamental provisions governed by this regulation.

…those covering regional cooperation…

PPP Provisions under GR 50/2007
Infrastructure sectors open for cooperation
All matters related to public services or public interest
Type of Cooperation
Cooperation Agreement
Partnership Object
Provision of public services, as authorised by the regional government
Mechanism of Business Entity/ Partnership Partner Procurement
By means of a bidding process
Incentives
Exemption/relief on import duties on imported capital goods; exemption/deferral of Value Added Tax on imported capital goods; amortisation; relief on Land and Building Tax; services and/or licensing facilities to obtain land rights (Right of Cultivation is a maximum of 95 years, Right to Build is a maximum of 80 years, and Right of Use is a maximum 70 years); immigration services facilities; import licensing facilities.

***Table 7.8**: Summary of the fundamental issues of PPP under GR 50/2007*

PR 38/2015 (Cooperation between Government and Business Entities in Infrastructure Provision)

…and those addressing cooperation between government bodies and the private sector in infrastructure provision.

This regulation is a newly enacted regulation replacing the previous regulation known as PR 67/2005 and its amendments. PR 67/2005, as amended, specifically addressed PPP for infrastructure provision and had been widely used as the main framework governing cooperation between government and private entities in infrastructure development in various sectors. In order to make PPP practices more effective, the government has replaced it with PR 38/2015.

Under PR 38/2015, the types of infrastructure, in which government may cooperate with private entities, are as follow:

The areas of infrastructure development, in which government-private sector collaboration is permitted, include waste management and power generation.

- transportation;
- roads;
- water resources and irrigation;
- drinking water;
- central waste water treatment;
- local waste water treatment;
- waste management facilities;
- information and telecommunication;
- power generation;
- oil and gas and renewable energy;
- energy conservation;
- urban facilities;
- educational facilities;
- sport and art infrastructure and facilities;
- regional infrastructure (infrastruktur kawasan);
- tourism infrastructure;
- health infrastructure;
- penitentiary; and
- public housing.

The regulation is strengthened by the Regulation of the State Minister of National Development Planning/Head of National Development Planning Agency No. 04 of 2015 concerning the procedures of Public Private Partnership for Infrastructure Provisions (Bappenas Regulation 04/2015).[4]

However, the implementation of PPP projects must also adhere to other regulations relevant to other specific sectors, particularly as regards the selection of the GCA, as stated in Article 6 paragraph 2 of PR 38/2015. In WtE projects, for example, while the sectoral regulations address the legislative requirements of waste and energy, as described above, other relevant regulations must also be adhered to. Thus, the general regulatory framework covering WtE projects under PPP mechanisms can be grouped as follows:

- PPP regulations;
- waste and energy sector regulations;
- cross-sectoral regulations; and
- regional government regulations (provincial and/or municipality).

[4] *PR 38/2015 requires new implementing regulations. According to article 47 of PR 38, there are three implementing regulations to be issued within 30 days of the enactment of PR 38/2015: the Operating Guide Manual (OGM), the Availability Payment and the Procurement of Investors. Bappenas Regulation 04/2015 provides the OGM; the other two regulations have not yet been issued.*

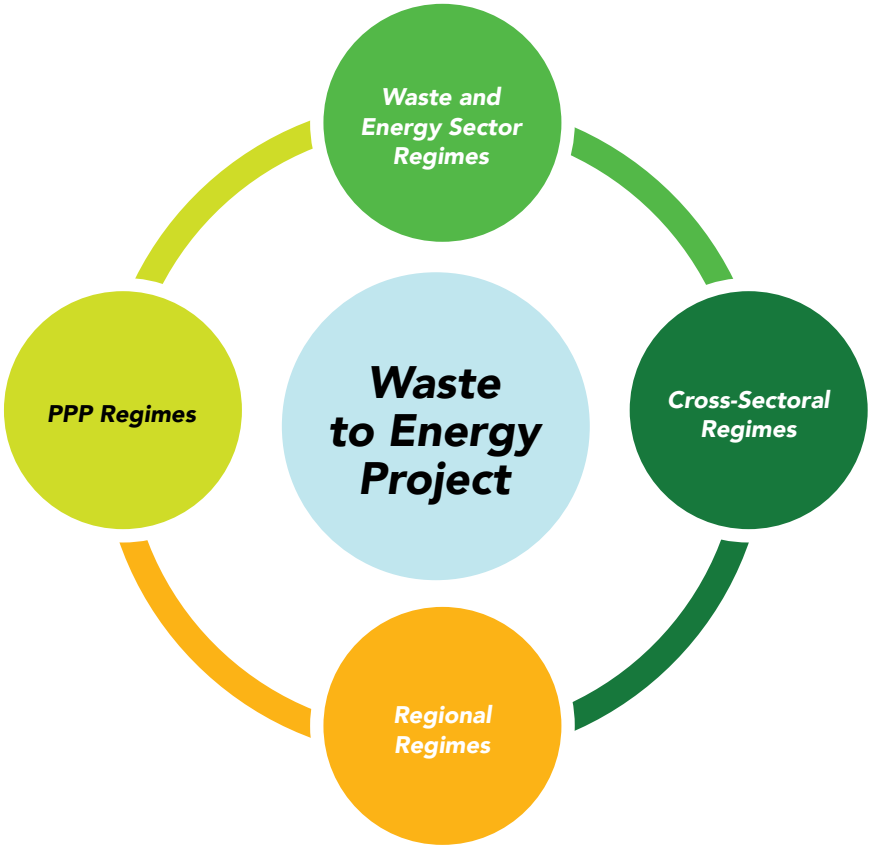


***Figure 7.4**: General regulatory framework of WtE projects under PPP mechanisms* [5]

PR 38/2015, as amended, addresses a number of fundamental issues in the development of infrastructure projects under a PPP mechanism; they are:

- the PPP cycle for a solicited project (project initiated by government);
- the selection of private investors;
- the PPP cycle for an unsolicited project (project initiated by a private entity);
- government guarantees;
- government support;
- the financial close;
- tariffs and adjustments;
- minimum provisions required under PPP agreements.

The arrangements for solicited (government initiated) and unsolicited (private sector initiated) projects differ. We look at each in detail.

We look at each of these issues in turn below.

The PPP cycle for a solicited project

Under PR 38/2015 there are three phases in PPP projects: planning; preparation; and transaction, in that order.

The planning stage involves the identification, budgeting, categorisation and selection of the PPP project.

The project preparation stage is intended to obtain an initial assessment of the feasibility of the project (Pre-FS) and to set out the government support and guarantee plan, the return of investment mechanism and the land acquisition plan.

[5] *Bastari Pandji Indra, Implementasi dan Tantangan KPS Dalam Pengembangan Waste to Energy, Bimbingan Teknis PPP Waste to Energy, Hotel Aston, Bogor, 24 September 2014.*

The project transaction stage involves several activities to draw up the contractual arrangements required to move the project forward, including the launching of a tender to select the private entity that will carry out the project, the cooperation agreement and financial close.

Under the competitive tender process for solicited projects, the initiator of the project may benefit from a number of privileges in the process, if they decide to go forward to tender.

The selection of private investors

PR 38/2015 states that private entities should be selected through open tendering or directly appointed for both solicited (state-initiated) and unsolicited (private sector-initiated) projects. It has been observed, especially in the case of unsolicited projects, that there has been some misunderstanding, leading to the assumption that the project initiator is automatically the sole private entity who will be awarded coperation agreement with GCA. This regulation states that both solicited and unsolicited projects must go through one of the selection processes. It does, however, stipulate a number of privileges for the project initiator, if they decide to go forward to a tender. We will look at unsolicited projects in more detail later in this section. Further details on the selection of private investors are given in Chapter 9.

The PPP cycle for an unsolicited project

Under PR 38/2015, as amended, an unsolicited project can be initiated by a private entity, if the project:

- can be integrated into the relevant sector's master plan;
- is economically and financially viable;
- has a project initiator with sufficient financial capacity to fund the project.

The approval process for unsolicited projects

The approval process begins with the appointment of a private entity as Candidate for Project Initiator/Badan Usaha Calon Pemrakarsa (BUCP). The BUCP submits the project feasibility document.

Under unsolicited projects, the GCA may compensate the private entity initiating the project, if the project is not ultimately implemented. The initiator also has the 'right to match' other bids.

Compensation for unsolicited projects

Before conducting the tender exercise, the GCA determines the pre-qualification requirements allowing the BUCP (candidate) to be accepted as the BUP (project initiator). As indicated earlier, the selection of a private entity must be based on a tender process, even in the case of an unsolicited project. However, the GCA may offer compensation to the BUP, as stipulated in PR 38/2015, by:

- adding 10 % to the BUP's score in the tender process;
- paying compensation for the Feasibility Study (FS) carried out by the BUP, in the event that the project is cancelled or not implemented by the BUP for whatever reason;
- allowing the BUP to change the tender, if, according to the result of the open tender, there are better bids from other business entities (the 'right to match').

The GCA issues a decree in order to determine form of compensation to be awarded to the BUP. In addition to the decree relating to compensation, in the case of unsolicited projects, the GCA will also issue decrees to confirm the partnership project as the approved unsolicited project and the private entities recognised as the BUCP and BUP.

Finally, any proposal from the BUCP and BUP to obtain government support and/or government guarantees may also be submitted at this stage.

Government Guarantees

PR 38/2015, as amended, stipulates that a PPP project may qualify for a government guarantee (GG). This guarantee is further governed by Presidential Regulation No. 78 Year 2010 concerning Infrastructure Guarantees (IGs) for Cooperation Projects between the Government and Private Entities (PR 78/2010). In addition, the GG is governed by the Regulation of the Minister of Finance No. 260/PMK.011/2010 concerning guidelines for the implementation of Infrastructure Guarantee in a Cooperation Project between the Government and a Private Entity (MoFR 260/2010).

The government guarantee is intended to ensure that the GCA is able to meet its financial obligations, as set out in the cooperation agreement.

PR 78/2010 states that an IG or GG means a guarantee in the form of financial responsibility taken on by the GCA through a guarantee agreement (GA) mechanism. The financial responsibility taken on by the GCA is backed up by the Minister of Finance (MoF) through the Indonesia Infrastructure Guarantee Fund (IIGF), a state-owned company created as a risk-sharing mechanism for cooperation projects between the government and private entities.

As stated above, the GG is awarded by the MoF through the IIGF. This means that the Minister of Finance is the authorised minister for dealing with these matters. Accordingly, the MoF is responsible for controlling and managing the risks associated with the GG. According to MoFR 260/2010, the MoF has the authority to: determine the criteria for the awarding of GG; request and obtain the data/information required from the parties forming the project partnership proposing to obtain GG; approve or reject the proposed GG; and determine the kind of GG to be awarded.

If a government guarantee has been agreed, then its provisions must form part of the tender documents used to select the private operator of the WtE facility.

If a GG is approved, then its provisions are included in the tender document used to select the private entity. In providing the GG, the IIGF may involve one or more additional guarantors (as a co-guarantee). Under MoFR 206/2010, the government, represented by the MoF, may act as co-guarantor. However, the government emphasises the importance of optimising the utilisation of GG through the IIGF for controlling the country's fiscal risk. On the other hand, the IIGF can act as a co-guarantor in cooperation with multilateral financial institutions for specific projects that have been approved by both parties.

If the proposed value of the guarantee exceeds the capital held by the IIGF, then the MoF may also participate in the awarding of the GG. If this happens, the IIGF will continue to process the proposed guarantee by submitting the results of evaluation and risk-sharing to the MoF, which will then further evaluate the proposal. If the MoF approves the proposed guarantee, the MoF will inform IIGF by means of a letter indicating its interest in providing the GG.

When implementing a GG award under PR 78/2010, the IIGF draws up and signs a guarantee agreement with the private entity ('the insured'). The regulation also stipulates that a minimum guarantee agreement should contain the following provisions:

- approval of the insurance cover by the guarantor and the insured;
- the procedures for the implementation of the obligations of the guarantor to the insured;
- the dispute resolution procedures between the guarantor and the recipient; and
- the Law of Indonesia as the applicable law.

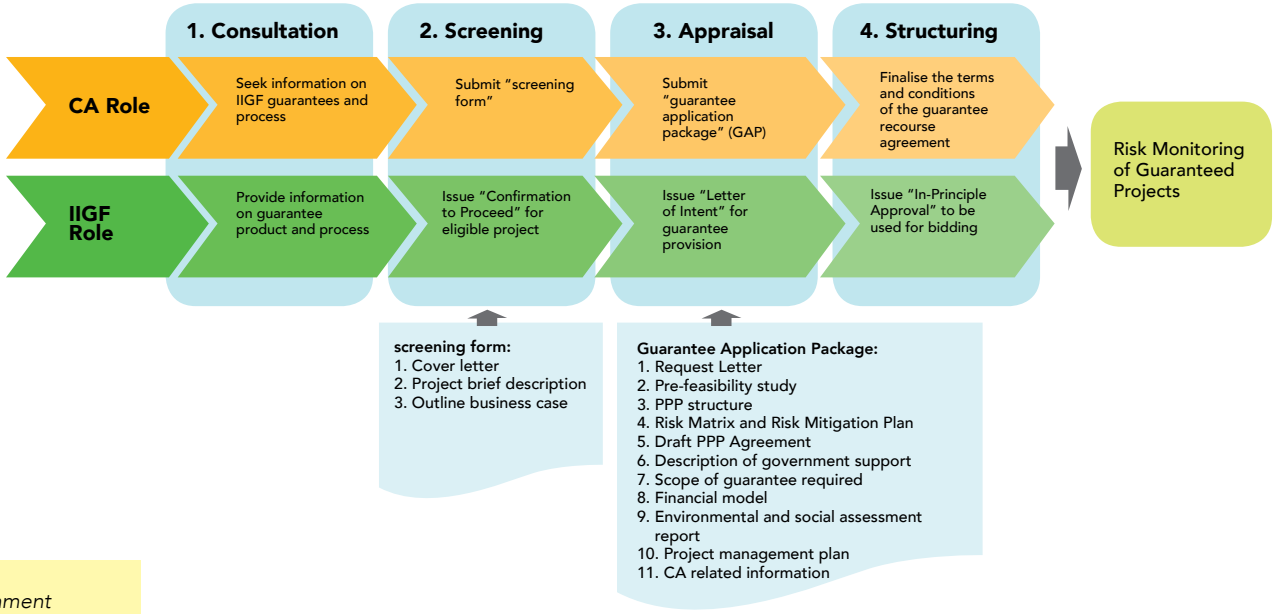


Figure 7.5: *The government guarantee application process*[6] *(described in more detail in chapter 10 of this guidebook)*

Government support refers to any financial or other support provided by the GCA or the Ministry of Finance to increase project effectiveness or viability.

Government support

According to PR 38/2015, in addition to the GG, the government may also provide support to the project, defined as any financial support and/or other forms of support awarded by the GCA and/or MoF based on its authority, in order to increase effectiveness and financial viability of a PPP project.

Financial Support

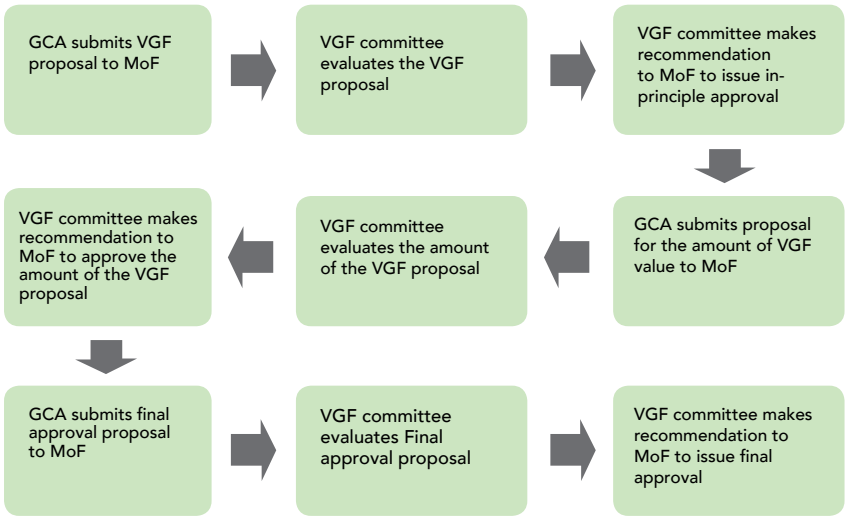
Under PR 38/2015, as amended, the form of financial support may include tax incentives, exemption from import duties and partial support for construction.

Limited government support is available for construction activites: here we set out the application and approval process required to obtain such support.

Relating specifically to the form of partial support for construction, the government has enacted Ministry of Finance Regulation No. 223/KM.011/2012 on Provision of Feasibility Support by Funding Part of the Construction of Infrastructure Project for Public Private Partnership Projects for Infrastructure Provision (MOFR 223/2012). Thus, if partial support for construction is required, this regulation allows the GCA to submit a proposal for support to the MoF.

This figure below provides a summary description of the approval process for partial support for construction. The process is described in more detail in Chapter 10, which covers financing.

[6] *Indonesia Infrastructure Guarantee Fund, Guidelines for Infrastructure Guarantee, pages 10-11.*



The winning bidder/ is required to conclude an agreement with a financing body within 12 months of the signing of the cooperation agreement. Though the term can be extended, failure to secure an agreement means that the cooperation agreement is automatically terminated.

Figure 7.6: *Application process for partial financial support for construction*

Other support

Government non-financial support may be provided in various ways depending upon the nature of the project. In the case of WtE projects, the most commonly required type of support is licencing, though other forms of support may also be needed.

The ability to acquire the necessary land is a fundamental issue for WtE projects. The arrangements are set out in the land acquisition framework which we looked at in detail on pages 105 and 106.

Licensing support covers all licences or approvals granted by the GCA for the implementation of infrastructure projects. In addition, the GCA also provides assistance in processing licences required from other relevant authorities, such as ministries or agencies.

Financial Close

PR 38/2015 stipulates that the SPC/winning bidder should enter into a financial agreement with a financing institution within 12 months of the CA being signed by the winning bidder and the GCA. A financial close is deemed to have been concluded when a financing agreement has been signed by the SPC and the financing institution and part of the loan can be used to commence construction.

The period of 12 months can be extended for another 12 months repeatedly by the GCA. An extension will be granted, if an error has been made by the GCA and if the error conforms to the criteria determined by the GCA. If the SPC fails to conclude a financial agreement within the said periods, cooperation is automatically terminated and the performance guarantee liquidated.

PR 38/2015 provides for financial close to be conducted over a number of stages, as considered necessary (partial financial close). Partial financial close is deemed to have been concluded when a financing agreement for one of the stages in the financial closure process has already been signed by the SPC and a financing institution and part of the loan proceeds can be used to commence the construction.

Land Acquisition Obligation

The GCA establishes a PPP coordination team to set up and monitor the progress of the PPP cooperation agrreement.

The requirement for land in the implementation of a PPP project is one of most important issues. Whilst the GCA normally leaves the issue of land acquisition to the private enitity, PR 38/2015 makes the requirement to obtain land one of the obligations of the GCA. The procedure and mechanism of land acquisition through the GCA are set out in the Land Acquisition Framework.

These regulations require both central and regional government (or the GCA) to acquire land to develop infrastructure in the public interest. WtE projects are categorised as infrastructures in the public interest in accordance with the prevailing laws and regulations. The procedures for land acquisition are described further in section 7.3 above, covering inter-sectoral regulations.

It should be noted that the maximum value of the performance gurantee is 5 % of the total investment value and that the transfer of shares prior to the commercial operation date by the winning bidder requires the GCA's approval.

It should be noted that, under PR 38/2015, there is a provision for the cost of land acquisition to be paid in advance by the GCA and then to be reimbursed by the winning bidder. If this is the case, such terms must be included in the tender documents. Accordingly, there is now an opportunity for the private sector to fund land acquisition, with the cost of this being repaid by the GCA through the APBN/APBD.

The PPP Coordination Team

To optimise evaluation and monitoring, the GCA should establish a PPP Coordination Team, whose duties include the formulation, synchronisation and coordination of policy, as well as the monitoring and evaluation of the PPP project.

Minimum provisions for PPP cooperation agreements

Regulations governing waste management at regional level stress the need to reduce household waste and maximise recycling, reduction and re-use (the 3 rs).

PR 38/2015 stipulates that a CA should contain the following minimum provisions:

- the scope of works;
- concessionary periods;
- the performance guarantee;
- the tariff and its adjustment mechanism;
- the rights and responsibilities of the contracting parties, including risk allocation;
- performance standards;
- the transfer of shares prior to the commercial operating date;
- non-performance penalties;
- the termination of the agreement;
- the requirement to publish the financial report in a national newspaper;
- the dispute settlement mechanism;
- the performance monitoring mechanism;
- the use and ownership of the infrastructure assets;
- asset transfer management;
- Force Majeure;
- representation and warranty;
- the prevailing language;
- choice of law, which is Indonesian law.

In practice, the CA may be updated to satisfy changing needs. Such updates may be allowed so long as the additions do not contradict prevailing regulations and are agreed by the contracting parties.

7.5 REGIONAL REGULATIONS

Under Law 18/2008, provincial/regional/municipal government must enact regional regulations to further regulate waste management services at municipal or regional level. These regional regulations also govern the permit requirements/approvals from the heads of regional government for those engaged in waste management. In addition, the regions have to prepare and allocate a development budget to finance waste management operations.

In support of the above law, the Ministry of Home Affairs, as the leading ministry for local government, has also issued a supporting regulation covering waste management at the regional level through the Ministry of Home Affairs: Regulation No. 33 of 2010 (MOHAR 33/2010). The regulation emphasises the need to reduce residential household waste and maximise its recycling, reduction and re-use (the 3Rs). The 3R activities are expected to provide economic value for the community and other parties and to generate additional income for the community. The regulation requires local government to establish waste management bodies from community through to district level in order to optimise 3R implementation.

The regulation also states that local government may build partnerships and cooperate with the private sector in waste management. The scope of such cooperation covers the collection of the waste management service fee/payments; setting up waste transfer stations; landfill infrastructure, facilities and equipment; waste transportation; landfill management; and other waste management activities. Cooperation between local government and the private sector must be conducted in accordance with the applicable laws and regulations in Indonesia.

Each regional government therefore can issue its own regional regulations and/or decrees to support its own WtE project initiatives. Examples of the subjects covered by regulations and/or decrees issued by the municipal government of Bandung include:

Regulations

- mid-term development plan/Rencana Pembangunan Jangka Menengah (RPJM);
- tipping fee;

Decrees

- choice of technology;
- selection of project initiator (for unsolicited projects);
- compensation for project initiator (for unsolicited projects);
- procurement committee;
- bidding documentation;
- bid winner.

Table 7.9: *The Land Acquisition Process*

Procedure (including the lead organisation responsible and any supporting document(s) required
Preparation of the LAP DOCUMENT. The GCA is required to prepare a Land Acquisition Procedure (LAP) document on the basis of a feasibility study. The content of the feasibility study is specified in the explanation to Article 15 paragraph (2) of Law 2/2012. The content of the LAP document is specified in Article 15 paragraph (1) of Law 2/2012. **Lead organisation**: GCA **Required supporting document**: Feasibility study
Approval of the LAP document. Once completed, the LAP document has to be approved by the GCA. **Lead organisation:** GCA
Submission of the LAP document. GCA is required to submit the LAP document to the governor of the province, in which the project is located. **Lead organisation:** GCA
Notification of the development plan. Based on the LAP document, the provincial government, together with the GCA, are required to deliver the notification of development plan, directly or indirectly, to communities living in the proposed development location. Notification can be in the form of socialisation, a face-to-face meeting, a notification letter, or through mass media. **Lead organisation:** GCA and provincial government **Required supporting document:** LAP document
Preliminary data collection of development plan location. Based on the LAP document, the provincial government, together with the GCA, is required to conduct the preliminary data collection about the development plan's location. The data collection must at least include data from the land rights holder and other relevant sources. Data collection is to be carried out within 30 business days after the notification date. **Lead organisation:** MPA and provincial government **Required supporting document:** LAP document
Public consultation about the development plan. Public consultation is required involving the land rights holders and other persons affected by the land acquisition. Minutes must be taken to record the results of the public consultation. The maximum duration of the public consultation is 60 business days. If an objection arises from the public consultation process, the consultation must be repeated with the objecting party only within 30 days. If the objecting party persists, the issue must be reported to the governor of the province, in which the project is located. **Lead organisation:** MPA and provincial government **Required supporting document:** LAP document
Settlement of objections by the governor. Upon receipt of a report of the existence of an objection (that has not been resolved), the governor is required to establish an objection assessment team (*tim kajian keberatan*) to carry out a review of the objection. The members of the team must be selected in accordance with Article 21 paragraph (3) of Law 2/2012. The team recommends whether the objection is accepted or not. The recommendation must be made within 14 business days. Based on this recommendation, the governor issues a decision regarding the objection.
Application for the issuing of a decree determining the location of the development. The GCA is required to deliver a request for the issuing of a decree determining the location of the development (surat persetujuan penetapan lokasi pembangunan or SP2LP). **Lead organisation:** GCA
Determining the SP2LP. The governor is required to issue the SP2LP within 14 business days after receiving the request letter from the GCA. The SP2LP is valid for two years and can be extended for another year. The land acquisition process must be completed within this period. If it is not completed within this period, then whole process must be repeated for any lands which have not been acquired. **Lead organisation:** Governor
Objections towards the SP2LP. If there are objections towards the SP2LP, the objecting party may submit a petition to the relevant state administrative court (pengadilan tata usaha Negara or PTUN) within 30 days as of the issuing of the SP2LP.

Continuation of Table 7.9.

Procedure (including the lead organisation responsible and any supporting document(s) required
Announcement of development location. The governor, together with the GCA, is required to announce the development's location has been determined. **Lead organisation:** GCA and governor
Approval of the LAP document. Once completed, the LAP document has to be approved by the GCA. **Lead organisation:** GCA
Implementation
Request for the implementation of land acquisition. The GCA is required to request to Land National Agency (Badan Pertanahan Nasional or BPN) to implement the land acquisition. **Lead organisation:** GCA
Inventory and identification of possession, ownership, usage and utilisation of land. These activities include: (a) the measurement and mapping of the land to be acquired; and (b) data collection from rights holders and other relevant sources relating to land acquisition. These activities must be carried out within 30 business days. **Lead organisation:** BPN **Required supporting document:** Establishment of the construction location
Announcement of inventory and identification. The results of the inventory and theidentification of location must be announced in the relevant local/ district offices (*kantor kelurahan/ kecamatan*) within 14 business days. **Lead organisation:** BPN
Objections to the inventory and the results of the identification. Any rights holders can submit an objection to BPN within 14 days of the announcement. BPN is required to follow up (revise the inventory/data collection) within 14 days. **Lead organisation:** BPN
Confirmation of the inventory and identification result. BPN is required to confirm the results of the inventory and location identification. **Lead organisation:** BPN
Appointment and announcement of an Appraiser. An appraiser must be appointed and announced. The appraisal must be carried out by an independent appraiser, who possesses a business permit from the MOF and is licenced by BPN to conduct land appraisals. **Lead organisation:** BPN
Appraisal. The appointed appraiser is responsible for conducting an appraisal of the land value. The land value must be as per the value when the SP2LP is announced. The result of the appraisal must be submitted to relevant BPN office. **Lead organisation:** Appraiser
Negotiation. After receiving the appraisal report, BPN then determines the compensation amount. BPN is required to carry out negotiations with the rights holders within a 30 day period in order to reach agreement about the amount of compensation. **Lead organisation:** BPN
Objection and settlement through court. If no agreement is reached during the negotiation process, the rights holder may submit a request to the district court for to determine the amount of compensation. Such a request may be made within 14 days after the end of the negotiation period. The district court is required to review and issue its judgment within 30 business days after receipt of such request. If the rights holder is not satisfied, then they may further appeal to the Supreme Court within 14 business days after the district court's judgment. If no request is submitted to the district court, it is assumed that the relevant rights holder has accepted the compensation offered by BPN.

Continuation of Table 7.9.

Procedure (including the lead organisation responsible and any supporting document(s) required
Payment of compensation and relinquishment of rights/ land. BPN is required to pay the compensation to the rights holder directly (except for such events listed in Article 42 paragraph (2) of Law 2/2012, under which payment is required to be placed in the relevant district court). The amount of compensation must be based on the figure agreed in the minutes and as decided by the court. Upon receipt of the compensation, the relevant rights holders must release their rights towards the land, and surrender any evidence proving possession or ownership of the relevant land to the GCA through BPN. If the relevant rights holder refuses to comply, the compensation payment may be placed in the hands of the relevant district court (*konsinyiasi*). **Lead organisation:** BPN
Handover of land by BPN to GCA. Once the compensation is completely paid (or placed in the hands of the relevant district court), BPN hands over the land being acquired to the GCA. The GCA is required to register the land under its name. **Lead organisation:** BPN and GCA

Chapter Checklist	✔
Now that you have read this chapter:	
Do you have an idea how much investment your WtE project requires?	
Do you know what investment vehicles there are and how to access them?	
Does your WtE project comply with the all the relevant legislation?	
Is your PPP arrangement in line with all the relevant legislation?	
Does your project need assistance in the form of government support or government guarantee and do you know how to apply?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 8

ORGANISATION AND OWNERSHIP STRUCTURES, AND PPP AT LOCAL GOVERNMENT LEVELS

WHAT THIS CHAPTER IS ABOUT

In this chapter we consider forms of ownership for landfill gas production facilities under public private partnership (PPP) schemes.

We describe the relationships between the stakeholders involved in waste to energy (WtE) projects under PPP schemes.

We look at the role of government bodies/agencies at central and local level (the institutional framework) and how all parties work together in WtE projects operated under PPP schemes (the contractual framework)

THE KEY POINTS

- ✔ Ownership models permitted under PPP schemes. *page 126*
- ✔ The role of government in WtE development at central, regional and local levels. *page 128*
- ✔ The standard contractual framework for a WtE project under a PPP scheme. *page 129*

8.1 OWNERSHIP UNDER PPP SCHEMES

As described in Chapter 8, the regulations governing PPP arrangements can be found in GR 27/2014, GR 50/2007 and PR 38/2015. However, these regulations define PPP in a different context, and PR 67/2005, as amended, specifically governs PPP schemes for infrastructure provision.

To be able to determine who the owner of a landfill gas production facility is, we must first understand how the existing regulations define the relevant government contracting agency (GCA). While PR 38/2015 provides for ministers, heads of state agencies, heads of regional government, as well as state-owned enterprises (SOEs) and regionally-owned enterprises (ROEs), to serve as GCAs, GR 81/2012 authorises only regional government to provide and operate the facilities.

Under PPP schemes, the local government is the owner of the landfill gas production or WtE facilities (the PPP assets). The private entity has the right to manage and operate the assets within the concessionary period. As with the independent power producer (IPP) schemes, asset management and ownership are covered by the cooperation agreement.

Whilst private entities are able to manage and operate the assets within the concession period under PPP schemes, the government retains ownership of the LFG production or WtE facilities (PPP assets).

8.2 THE ROLES AND AUTHORITIES OF THE CENTRAL GOVERNMENT INSTITUTIONS

Building on the description of the legal and regulatory framework already described in Chapter 7, we now look at the typical institutional framework for WtE projects under PPP mechanisms in Indonesia (by "institutions" we mean here those government institutions and/or agencies involved in WtE projects) and how they interact. The following illustration provides an overall view of the institutional framework in WtE projects.

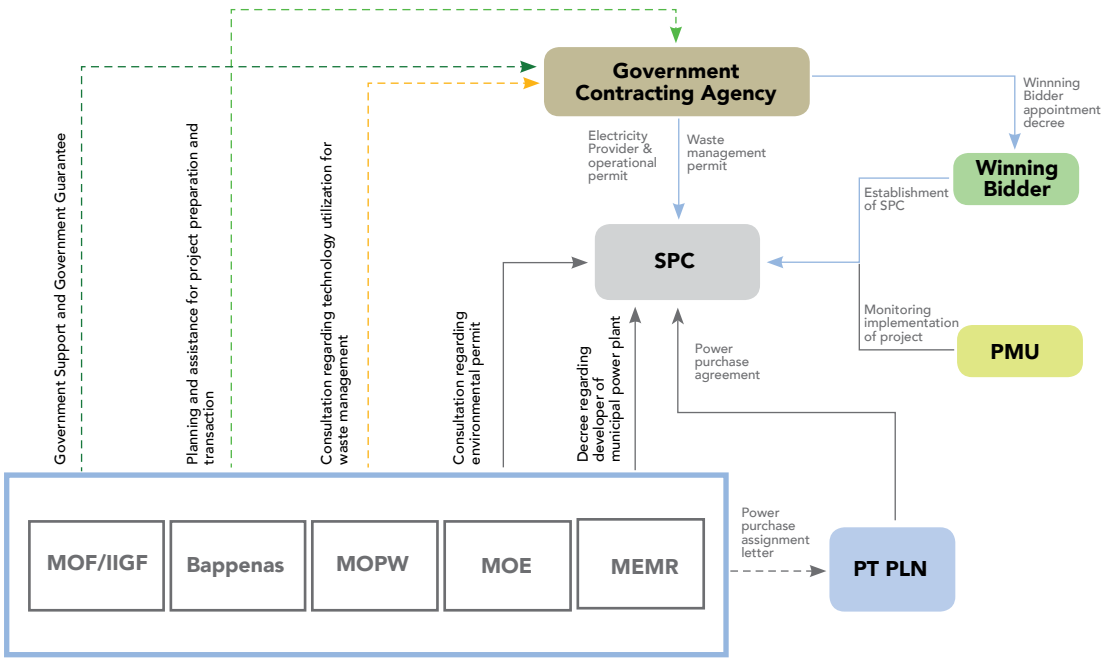


***Figure 8.1**: The big picture of the institutional framework for WtE projects under PPP mechanisms* [1]

Many government institutions at ministry or equivalent level support GCAs under WtE projects , including project implementation and development, identification of suitable technologies, environmental matters and permitting and contractual issues.

As the figure above shows, WtE projects under PPP mechanisms involve many government institutions. The primary institution is the regional government, which acts as the GCA. The GCA is supported by central government institutions, each with their own roles and responsibilities, which should be understood by the GCA, as follows:

- the Ministry of Finance (MoF), which, through its Risk Management Unit and Directorate General of State Assets, supports the implementation of projects in the event that the projects require state assets or project development assistance;
- the National Planning Board (BAPPENAS), which supports project implementation by including them on the list of national priority projects and supervises and manages every phase of the project up to commercial operation;
- the Ministry of Public Works (MoPW), which provides advice to the GCA on the selection and use of appropriate waste management and landfill and technology;
- the Ministry of Environment (MoE), which provides advice on environmental permits as required by the special purpose company (SPC) to develop and operate the project; and
- Ministry of Energy and Mineral Resources (MEMR), which supports project implementation by working with PLN to ensure that all the electricity produced by the SPC is purchased.

Below central ministry level, many other government agencies provide assistance to GCAs in areas such as land acquisition, financing and legal questions, risk management, inward investment, licensing, guaranteeing the required quantities of waste feedstock and ensuring a market for the electicity produced.

In addition to these institutions, other government institutions and/or agencies may also be involved in supporting WtE projects, including:

- the National Land Agency (BPN), which acquires land in accordance with the prevailing laws and regulations described in chapter 7;
- PT Sarana Multi Infrastruktur (Persero) (PT SMI), which provides financial support and may give contractual assistance, if instructed by the MoF;
- the Indonesia Infrastructure Guarantee Fund (IIGF), which provides guarantees against potential risks identified by the GCA or other government institutions with the purpose of increasing the bankability of the project in the eyes of investors;
- the Indonesia Investment Coordinating Board, Directorate of Infrastructure Planning (BKPM), which acts as the "front office" of the project when it is being promoted to investors, and licenses the legal entity;

The GCA is the primary regional authority responsible for setting up the business entity to build and operate the WtE facilities and for arranging for the necessary operating permits.

[1] *Bastari Pandji Indra, Implementasi dan Tantangan KPS Dalam Pengembangan Waste to Energy, Bimbingan Teknis PPP Waste to Energy, Hotel Aston, Bogor, 24 September 2014.*

If the waste being considered as feedstock for a WtE project is being segregated, potential investors must carefully consider whether the fuel stream post segration is going to aid or hinder power production.

- PT Perusahaan Listrik Negara (PLN), which is responsible for entering into the power purchase agreement with the SPC and for purchasing the electricity produced by SPC, thereby helping to encourage external investment in the WtE plant;
- the Regional Sanitation agency (responsible to the GCA), which is responsible for collecting, transporting and supplying the feedstock to landfill gas facility. This agency is responsible to the GCA.
- the Regional Sanitation agency (responsible to the GCA), which is responsible for collecting, transporting and supplying the feedstock to the landfill gas facility;
- the National Procurement Agency (LKPP), which is responsible for overseeing PPP procurement policies; this agency may assist the GCA by ensuring that procurement activities are carried out in accordance with regulations and, indeed, by providing capacity-building to the bidding committee.

8.3 THE ROLES AND AUTHORITIES OF GOVERNMENT INSTITUTIONS AT THE REGIONAL LEVEL

A number of regional institutions are involved in WtE projects

The rights and responsibilites of all stakeholders involved in the construction and operation of the WtE facilities are set out in the cooperation agreement or contract.

The GCA, as the regional authority responsible for implementing WtE projects, has an essential role to play in setting up the business entity and issuing any licences it requires to operate waste management facilities. In the event that the regional government has not allocated finance from its local budget for the cooperation project, the regional parliament must be consulted and give its approval to the draft cooperation agreement. In addition, the Regional Spatial Agency, the Regional Public Works Agency, the Regional Development Planning Agency and the Regional Environmental Impact Assessment (EIA)/AMDAL Commission are the technical bodies under regional government that may be appointed by the head of region to supervise and evaluate the project and ensure it complies with the prevailing laws and regulations. The Sanitation Agency is responsible for collecting and transporting the waste to the waste management facility constructed by the SPC.

The institutional arrangements are summarised in Table 8.1 below.

Agency	Role
Regional Level	
GCA /Head of Region	Setting up the business entity to design, build, operate and maintain the WtE infrastructure. Entering into a cooperation agreement with the winning bidder, approving and issuing licences and approvals related to waste management permits and electricity business licences. Approving/preparing the EIA document, providing land for project implementation and ensuring that the project is included in the regional spatial plan.
Regional Parliament	Approving budget allocation for the tipping fee payment, approving the draft of the cooperation agreement.
Regional Spatial Agency (Dinas Tata Ruang dan Bangunan)	Responsible for recommending to the head of region that the proposed project should be incorporated into the regional spatial plan and for supervising the implementation of construction activities in line with the city/region spatial plan.
Regional Public Works Agency (Dinas Pekerjaan Umum)	Responsible for advising on the appropriate type of landfill for the WtE project, providing related infrastructures, preparing the master plan, developing and rehabilitating the landfill.
Regional Development Planning Agency (Badan Perencanaan Pembangunan Daerah)	Responsible for the preparation of the regional medium-term development plan.
Regional EIA Commission	Assessing the environmental (EIA) documents and issuing recommendations to the head of region for the issuing of environmental permits.

***Table 8.1**: Stakeholders in regional governments*

8.4 THE TYPICAL CONTRACTUAL FRAMEWORK FOR WTE PROJECTS IN INDONESIA

For WtE projects operating under a PPP mechanism, the legal basis that sets out the rights and responsibilities of the GCA and the private entity is the cooperation agreement or contract. In addition, contractual arrangements are also required to take account of the other stakeholders most likely participating, such as electricity off-taker, financing institution(s), bond holders and other related parties.

The figure below shows an example of a typical contractual framework for a WtE project under a PPP scheme.

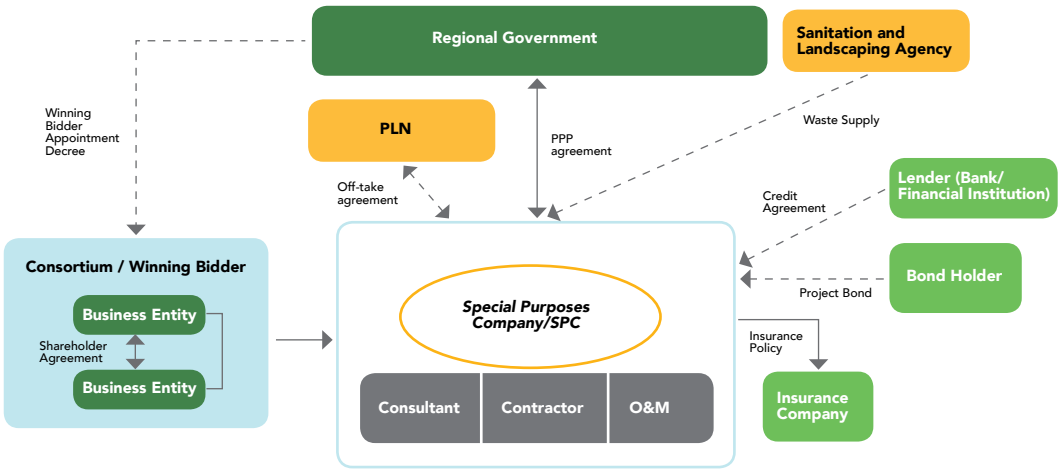


***Figure 8.2**: The contractual framework for WtE under Public Private Partnership* [2]

The winning bidder selected to construct and manage the WtE facility does so through the auspices of a special purpose company.

The project development phases provided for under this contractual framework are as follows:

- the regional government, as the GCA, issues the decree naming the winner of the bid;
- the bid winner signs the shareholder agreement to establish the business entity/SPC to construct and operate the waste management facility:
- the regional government enters into a cooperation agreement with the SPC, setting out the rights and obligations of the parties during the concession period;
- the SPC establishes and operates the waste management facility (undertaking these activities itself or with authority to sub-contract the work to a third party), and is required to seek funding through a financing institution to operate the plant;
- the SPC may appoint an insurance company;
- in the operational phase, the regional government, through the Sanitation Authority/ Regionally-Owned Sanitation Enterprise, supplies the waste the facility needs to operate and produce the electricity to be delivered to PLN , with quality and quantities in accordance with the shareholder cooperation agreement.

Whatever type of scheme is selected for the construction and operation of the WtE facilities, the SPC must eventually transfer ownership of the assets to the GCA.

[2] *Bastari Pandji Indra, Implementasi dan Tantangan KPS Dalam Pengembangan Waste to Energy, Bimbingan Teknis PPP Waste to Energy, Hotel Aston, Bogor, 24 September 2014.*

8.5 CONTRACTUAL MODALITIES

PR 38/2015 recognises the various types of cooperation scheme available, such as build-own-operate-transfer (BOOT), build-operate-transfer (BOT), build-transfer-operate (BTO), rehabilitate-operate-transfer (ROT) and develop-operate-transfer (DOT). Whatever the scheme, the SPC is obliged to transfer ownership to the GCA.

While the condition for transfer is usually the lapse of the concession period, the PPP agreement may contain a default to trigger the transfer before that. It is vital, therefore, that the PPP contract agreement should set out all the conditions for transfer in specific detail in order to minimise the potential for disputes.

Chapter Checklist	✔
Now that you have read this chapter:	
Are you familiar with the ownership models permitted under PPP schemes?	
Do you understand the role of government in WtE development at central, regional and local levels?	
Do you know the standard contractual framework for a WtE project under a PPP scheme?	
Do you know how to form a special purpose company?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 9

MODELS FOR TENDERING UNDER PPP (PUBLIC PRIVATE PARTNERSHIP) SCHEMES

WHAT THIS CHAPTER IS ABOUT

In this chapter we look at the tendering and evaluation models for engaging private entities under public private partnership (PPP) arrangements to scope, design, construct, finance, manage and operate waste to energy (WtE) plants as part of landfill operations.

We describe the latest procurement arrangements and provide easy-to-use checklists covering each stage of the process: pre-qualification, bidding, announcement of the winner and contract implementation.

We explain the difference between solicited and unsolicited projects.

We consider the specific difficulties of tendering in Indonesia.

THE KEY POINTS

- The legislation governing tendering for PPP projects in Indonesia. *page 132*
- The detailed procedures and requirements at each stage of the tendering process. *page 134*
- Procedures for selection of private entities. *page 136*
- The challenges bidders are likely to face when tendering for PPP projects in Indonesia. *page 143*

9.1 THE LEGAL BACKGROUND

Tendering is a crucial element in the development of ppp infrastructure projects. It is the phase, in which the government contracting agency, through its procurement committee, evaluates potential wte operators in order to select the right private entity to finance and carry out the project.

Presidential Regulation PR 38/2015 sets out the primary principles for procurement arrangements covering the tendering for PPP projects. Procurement for PPP projects is further governed by the regulation of the Head of the National Procurement Agency No. 19 of 2015 (Perka LKPP 19/2015).

According to Perka LKPP 19/2015, the procurement of private entities must adhere to the underlining principles of efficiency, effectiveness, transparency, openness, competitiveness, fairness and accountability.

Solicited projects are government-led, whilst unsolicited projects are initiated by the private sector. Both types must go through a formal selection process.

The Perka classifies PPP projects as solicited or unsolicited projects. While a solicited project is government-led, an unsolicited project is private entity-led. The regulation requires that private entities should, in principle, be selected through open tendering or directly appointed for both solicited and unsolicited projects. It has been observed, especially in the case of unsolicited projects, that there has been some misunderstanding, leading to the assumption that the project initiator is automatically the sole private entity who will be awarded cooperation agreement with GCA. This regulation states that both solicited and unsolicited project must go through one of the selection processes. It does, however, stipulate a number of privileges for the project initiator, if they decide to go forward to a tender. We will look at unsolicited projects in more detail later in this section. In principle, the open tendering exercise comprises pre-qualification (PQ), bidding and PPP contract implementation stages. This chapter describes each of these stages, setting out the procedures, which typically have to be followed under open tendering methods for PPP projects in Indonesia. It addresses solicited and unsolicited projects separately; in the case of the latter, where the initiatives emanate from the private sector, there are options for the government side to grant incentives to the project initiator. The conditions and procedures are sometimes long and relatively complex and, for this reason, where appropriate and helpful, we have set them out in the form of checklists which can be easily followed.

While open bidding is the preferred procurement method, direct appointment is possible under certain circumstances.

Article 38 of PR 38/2015 allows tendering of private entities to be conducted either through open tender or by direct appointment. However, both methods must involve a PQ process. While open bidding is the preferred method, PR 38/2015 allows for direct appointment, if certain conditions are attached to the PPP project[1] or if PQ results in only one pre-qualified business entity. We describe the bidding processes in more detail below.

[1] *Certain conditions mean: a) development of an infrastructure that has previously been built and/or operated by the same business entity; or b) by the nature of project it can only be carried out by specific technology available from a single investor.*

9.2 PPP AND THE PROCUREMENT COMMITTEE

As already indicated, the tender process, whatever method is applied (open bidding or direct appointment), should begin with PQ, which itself is preceded by the Government Contracting Agency (GCA) forming a PPP committee and procurement committee.

The PPP Committee (Tim KPBU)

The PPP Committee is tasked with assisting the GCA with all transaction activities up financial close, including, if necessary, assist the procurement of private entities. Its responsibilities are therefore as follows:

- coordinating with the Procurement Committee during;
- drawing up the terms of reference for procuring a Preparation Body[2] ; and
- helping the GCA monitor the bidding process.

The Procurement Committee

The GCA is assisted by a Procurement Committee, the responsibilities and composition we list here.

The procurement committee has the following responsibilities:
- assigning the procurement documents and amendments (if any) after the GCA's approval;
- managing the data and information in the data room;
- announcing the execution of the procurement process;
- assessing the qualifications of participants during PQ;
- providing explanations of procurement documents;
- evaluating the technical and financial ability of the participants to tender;
- exploring options to improve the two- stage tender;
- negotiating;
- proposing the selected bidder;
- proposing the selection of the private entity through direct appointment;
- coordinating with the PPP team during the procurement process;
- reporting on the execution of the procurement process periodically to the GCA;
- submitting the original procurement documents to the PPP team after the procurement process is completed; and
- submitting copies of the procurement documents to the GCA.

The criteria for the establishment and operation of the Procurement Committee are as follow:
- the number of committee members must be least be five persons and can be added to, if required;
- the members must be drawn from the GCA itself and related working units;
- the members may be drawn from the procurement services unit (ULP) staff in ministries/ institutions/local government;
- the members of a Procurement Committee appointed by a state-owned enterprise/local government-owned enterprise acting as the GCA must be drawn from that enterprise;
- the members of the Procurement Committee must be familiar about: procurement procedures; KPBU procedures; the scope of the project works; the legal agreement and the laws applicable to infrastructure projects; the technical aspects of the cooperation project;

[2] *Preparation Body means an institution selected nationally or internationally to provide advice and/or funding during the preparation and transaction of a PPP project, or only during the transaction a PPP project.*

the business and financial aspects of the cooperation project.

- procurement committee members are prohibited from having any affiliation with the other procurement committee members and/or with the GCA and/or participants in the same procurement process for the same PPP project; and
- the members must have signed an agreement (integrity agreement) to act in an honest and responsible manner.

The decisions of the Procurement Committee are based on consensus, with assistance from external experts, if required.

The Procurement Committee should reach its decisions through consensus. In the event that consensus cannot be reached, the decision is taken by majority vote; in this case, each member has a single vote which cannot be transferred to another member. Professional experts and/or a preparation agency may assist the Procurement Committee in its procurement duties.

9.3 TENDER PREPARATION

The Bidding Committee's activities are to:

- confirm the PPP project's readiness to proceed to the selection of business entity phase;
- confirm market interest;
- prepare the procurement schedule and draft the tender announcement;
- draft the tender document; and
- manage the data room and information for the due diligence process.

Confirmation of the PPP project's readiness to proceed to the selection of business entity phase

A PPP project must meet a number of criteria, set out in Bappenas Regulation 04/2015, before it can proceed to formal selection of the private sector entity, including…

The project is confirmed as ready to proceed using a project readiness checklist. Bappenas Regulation No 04/2015 stipulates that the checklist should include the following:

- the regulatory and institutional framework;
- the technical aspects;
- economic and commercial aspects;
- environmental and social aspects;
- forms of cooperation in infrastructure provisions;
- risks;
- Government Support and Guarantees; plus
- any other documents required.

The checklist should also include the needs assessment concerning the provision of land. Accordingly, the GCA should draw up a land acquisition plan that determines the project's location. In addition, the checklist should also provide a public consultation document confirming the location and the readiness of the project to proceed.

Confirmation of market interest

…confirmation that there is market interest in the project.

The Procurement Committee is responsible for determining the level of market interest in the PPP project. The committee may approach this in a number of ways, including, but not limited to, assessing the results of market interest research conducted by the GCA or through discussions forums with prospective business entities.

Preparation of the procurement schedule and the draft of announcement of the tender

The procurement schedule should give sufficient time for all stages of the process. After the schedule has been drawn up, the Procurement Committee announces
the start of the tender process, beginning with PQ. The announcement should be made through media with wide geographical reach and/or that can reach substantial numbers of participants. We look at the basic information the announcement should contain in more detail later in this section.

Drafting and determining the tender document

The Procurement Committee is responsible for drafting the tender documentation, including the Pre-qualification documents and the Request for Proposal (RfP), on the basis of the project information and confirmations of location and market interest described above. Once approved by the GCA these documents become the official tender documents.

The Procurement Committee produces the pre-qualification documents and the Request for Proposal (RfP), which, once approved by the GCA, become the official tender documents.

The Procurement Committee is responsible for drafting the tender documentation, including the Pre-qualification documents and the Request for Proposal (RfP), on the basis of the project information and confirmations of location and market interest described above. Once approved by the GCA these documents become the official tender documents.

The pre-qualification document should contain the following provisions as a minimum:

- the background and a brief description of the PPP project;
- the purpose of the project;
- the objective and scope of the cooperation;
- Important information related to the PPP project;
- the qualification requirements of the participants; and
- a description of the qualification process, including the schedule, the assessment procedures, events/items that could abort the qualification process, and the form and format of the qualification documents.

The RfP should contain the following provisions as a minimum:

- general information about the PPP project;
- instructions to bidders;
- arrangements for opening and evaluating the tender documents;
- measures to prohibit corruption, collusion and nepotism (KKN), fraud and conflict of interest;
- the service and technical specifications required;
- the risk allocation matrix;
- payment mechanisms;
- the financial model, including the source of funding;
- compliance requirements, including legal aspects;
- any guarantees and their conditions;
- any other matters deemed necessary for inclusion in the RfP by the Procurement Committee; and
- an attachment comprising the Information Memorandum, a draft KPBU agreement draft, the main provisions of the guarantee agreement (if requiring a government guarantee) and any other documents required.

The pre-qualification documents and the RfP require considerable details about the project, including, amongst other things, its purpose, technical specifications, location, financing, risk mitigation. We provide a full list of the requirement here and further details in the Annex to Chapter 9 on page 186.

Management of the data room and information for the due diligence process

Bidders who pass the PQ stage and have submitted a letter of confidentiality are given access to a data room and information, containing the following documents:

- documents related to the PPP project;
- the Tender document, plus amendments (if any); and
- copies of the tender documents distributed to all bidders.

9.4 TENDER IMPLEMENTATION

9.4.1 Selection of Private Entities

The implementation phase of the tendering process includes Pre-qualification and Selection activities, which can be carried out through open bidding or direct appointment.

a. Pre-qualification (PQ)

Bidders must show themselves to have the required technical know how and be legally, commercially and financially compliant.

In order to take part in PQ, a bidder must:

- comply with the prevailing regulations required to run a business;
- have the experience and capability to finance and execute a PPP project (in the case of a consortium, while the consortium's previous experience and financing capabilities are scored in aggregate, at least one of the consortium members must have previous experience and proven capability in carrying out a PPP project);
- comply with the tax obligations;
- not be in receivership or bankruptcy, and not have their business activities suspended;
- not have a conflict of interest;
- (referring to bidders that are foreign legal entities) must have documents issued by other countries for use in Indonesia legalised by a public notary in the country where the document was issued and legalised by an Indonesian embassy or Indonesian consulate;
- (referring to bidders that are international legal entities or institutions/international organisations) promote the principles of good procurement and also comply with the taxation requirements of the country concerned.

If the bidder is an Indonesian legal entity, the statement letter must be signed over a duty stamp; in the case of a foreign legal entity, the statement must be certified by a public notary and also certified by the Indonesian embassy or consulate in the country where the statement was signed.

The participants of the PQ process can be either single business entities or a consortium. In the case of a consortium, there must be a consortium agreement setting out the obligations and responsibilities of each business partner and the name, obligations and responsibilities of the consortium leader representing the consortium. More than one business entity can act as the consortium leader but, if this is the case, one business entity should be appointed as the consortium's official representative. The leader of the consortium should hold a majority of shares in the business entity formed.

Whilst a consortium may be led by more than one business entity, one entity must be selected as the consortium's official representative.

Business entities, institutions or national/international organisations carrying out the same PPP project cannot take part in the PQ exercise. Similarly, members of a consortium, which are participating as members, or in any other way, either direct or indirectly, in another consortium at any stage, or which become part of a single business entity in the same PPP project, cannot take part.

The stages of the PQ exercise are as follows:

- the announcement of the pre-qualification exercise;
- the registration and collection of the PQ documents;

- clarification of the PPP project;
- submission of the PQ documents;
- evaluation of the PQ documents;
- the announcement of the results of the PQ exercise; and
- dealing with any objections raised.

As a minimum, the assessment of the bidders' qualifications will consider their ability to comply with the administrative requirements, and their technical and financial capabilities. If the PQ exercise results in the qualification of more than one qualified private entity, then selection follows procurement. However, if the exercise produces only one qualified bidder, the next step is direct appointment.

Pre-qualification announcement

The pre-qualification announcement should be made directly to all potential bidders, at least once through national and/or international newspapers and should be posted on the GCA's website until the end of the PQ document collection period. The announcement period must be at least 7 working days. The announcement should include the following information:

- the details of the GCA;
- the project brief, giving the project's objective and legal basis, and the scope and form of the cooperation
- the estimated value of the investment;
- the PQ requirements;
- the venue, date and time to collect the PQ documents.

The pre-qualification announcement issued by the GCA's procurement committee must include:

- *the GCA's contact details;*
- *a description of the PPP project;*
- *an estimated project value;*
- *the services required;*
- *submission details (time, date and place).*

It must be placed on the GCA's website, in national and local printed media and, if required, international media.

Registration and Collection of the PQ document

The prospective bidder must register and collect the PQ document at the venue on the day and at time indicated in the announcement; the time allowed for this starts on the date of announcement and runs until the deadline of the PQ document submission. The document must be collected by an authorised person representing only one bidder. Alternatively, registration and document collection may be done electronically.

Clarifications

Clarifications should be given in an open, transparent and non-discriminatory manner. Clarifications may be given to clarify, or to respond to questions concerning the PQ documents and/or the PPP project itself. Technically, such clarifications may be given in ***writing and during a pre-submission conference***. Not attending the clarification session or requesting clarification in writing does not disqualify a bidder from the right to submit the PQ and/or the RfP. Should any changes result from these clarification exercises, the PQ documents should be amended accordingly prior to the deadline of PQ document submission, and any such amendments should be distributed to all bidders. If no one is present, the minutes of the clarification exercise should only be signed by the tender committee.

Any clarifications given must be provided in an open and non-discriminatory manner to all bidders.

Submission of PQ Documents

The PQ documents should be submitted in accordance with the schedule stipulated. Changes to the PQ document can only be made prior to the submission deadline. The PQ documents comprise:

- Administrative documents (confidentiality agreement; business licence; Articles of Association; the authority to sign the PQ document; the structure of the board of directors, the board of commissioners and shareholders; a statement that the bidders have not committed a criminal act; experience of having carried out a similar PPP project; information about any relevant disputes; and a consortium agreement, if any).

The documents required for pre-qualification call for detailed administrative, technical and financial information about the bidders.

- Technical documents (documents which indicate experience of investing in a similar PPP project, including financing, developing and operating the project; and, a shareholder sponsorship agreement, if the bidder has been established for less than one year).

- Financial documents, including an audited financial report for the last 3 years, a bank reference and, in the event the bidder has been established for less than one year or is deemed financially incapable, a sponsor agreement from the shareholders.

Evaluation of the Qualification Process

Qualification is based on a simple 'pass/fail' system, requiring full and detailed disclosure and the answering of all the questions contained in the pre-qualification documents.

Qualification is decided on the basis of a simple pass/fail system (sistem gugur) in accordance with the requirements of the PQ document. A bidder should not be disqualified purely for administrative reasons. A decision to disqualify should be based only on the substance of the qualification documents submitted. For this reason, the committee should evaluate the administrative, technical and financial aspects of the submissions, paying particular attention to:

- the completion of the data required;
- the clarity and authentication of the information contained in the documents.

The result of the evaluation is recorded in minutes signed by the bidding committee. If no one passes the qualification exercise, the PQ exercise is deemed to have failed.

PQ result and announcement

The tender committee will determine those who pass PQ stage and will announce it to every bidders through electronic mail and through media such as the GCA's website and newspaper.

Objections to the Result of the Pre-qualification Exercise

Procedures exist for bidders to challenge the results of the tender exercise.

Objections must be based on violations of the regulations and procedures set out in the PQ document. A bidder making a PQ submission therefore has the right to file an objection and provide supporting evidence. The period for filing an objection is 5 working days from the date of the announcement of the result. An objection does not stop the PQ process. The GCA must respond to the objection within 5 working days. If the GCA does not respond to the objection, the objection is considered to have been rejected. If the objection is subsequently upheld, the GCA may re-run the evaluation or announce that the PQ exercise has failed.

PQ exercises are deemed to have failed totally under the following circumstances:

- no participants submit PQ documents;
- no business qualify; or
- the GCA considers that objections are valid because of allegations of corruption, collusion and nepotism and/or violations of fair competition in the implementation of the PQ; or if the PQ document has not been submitted in compliance with the prevailing regulations.

GCAs should investigate any failure to complete a pre-qualification exercise, asking the Procurement Committee to re-run the process and, if required, examining the process itself.

If the pre-qualification exercise is deemed to have failed, the GCA reviews the reasons for the failure. After this, the GCA may ask the Procurement Committee to re-run the PQ. If the re-run PQ process fails, the procurement process should be discontinued and the GCA should review the PPP project preparation practices.

b. Selection of Private Entities

Following the PQ, selection can continue through either open tendering or direct appointment. In the case of open tendering, the bidding may go through either a single-stage or a two-stage process. Single-stage bidding is used when the specification is clearly described and does not require any technical improvements to reach optimum output. Two-stage bidding is used when the specification is not clearly described and some innovative or technological changes are required.

A direct appointment can be made under two conditions: 1) the PPP project falls under the 'Specific Conditions'; or 2) pre-qualification produces a single pre-qualified bidder. The term 'Specific Conditions' means that: a similar infrastructure development has already been carried out and/or previously operated by the same private entity; the work can only be carried out using new technology available from only one service provider; or the prospective private entity holds a majority stake in the land required to perform the project.

Direct appointments may be made, if the 'Specific Conditions' are met, i.e. the bidder has already carried out this type of work, is in unique possession of the technology needed or has a majority stake in the land required.

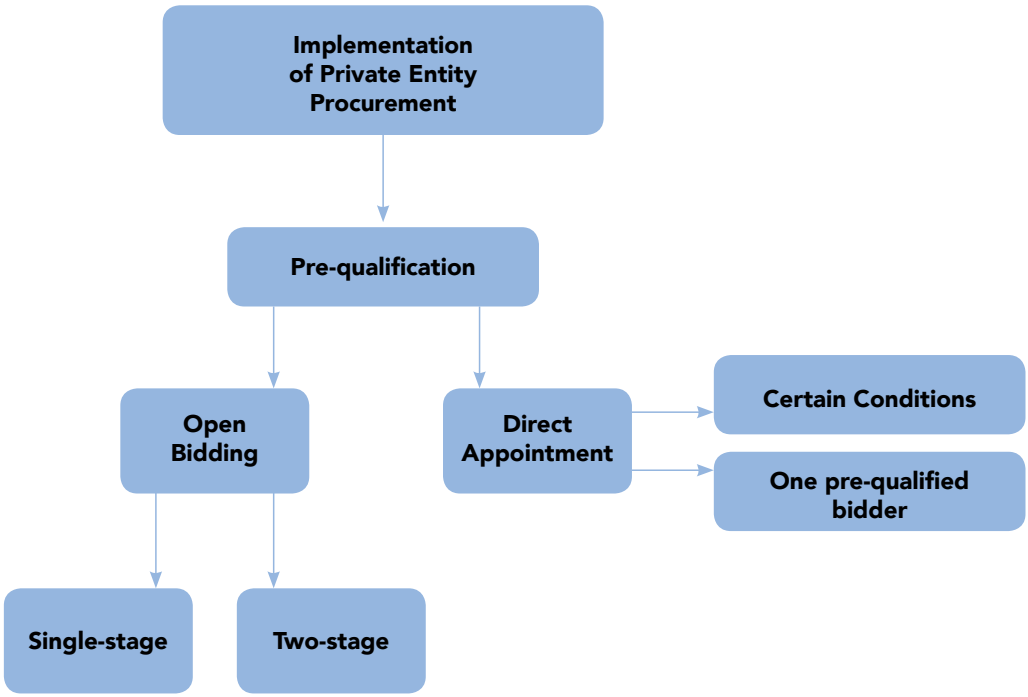


Figure 9.1: *The flowchart of the PPP procurement process*

a. Single-stage open bidding

Tendering through single-stage bidding comprises the following steps:

- distributing the Request for Proposal (RfP) to the shortlisted bidders;
- issuing the non-disclosure letter;

The bidding method can vary from tender to tender and should be studied carefully by the bidders. It is invariably based on the two envelope procedure to separate the technical and financial parts of the bids.

The pre-bid conference is used to set out how the bidding process will be managed, provide detailed submission requirements, explain how the bids will be evaluated and the how the cooperation contract and bid bond will operate.

- the pre-bid conference;
- amendment of the RfP (if necessary);
- submission the bid – envelope I and envelope II;
- opening of the bid – envelope I;
- evaluation of the contents of envelope I;
- announcement of the results of the evaluation of envelope I;
- opening of the bid – envelope II;
- evaluation of the contents of envelope II;
- issuing of the minutes of the tender process;
- awarding the tender winner;
- announcement of the tender winner;
- objections;
- issuing of the award letter; and
- preparation of the PPP contract for signature.

b. Two-stage open bidding

Two-stage tendering comprises the following steps:

- distribution of the RfP;
- issuing of the non-disclosure letter;
- the pre-bid conference;
- amendment of the RfP (if necessary);
- submission of the bid – stage I (administration and technical documents);
- opening of the bid – stage I;
- evaluation of stage I;
- announcement of the result of the stage I evaluation to all bidders;
- discussions concerning technical improvements, financial aspects and the drafting of the PPP contract;
- amendment of the RfP (if necessary);
- submission of the bid – stage II (technical and financial documents);
- opening of the bid – stage II;
- evaluation of stage II;
- issuing of the minutes of the tender process;
- award of the tender winner;
- announcement of the tender winner;
- objections;
- issuing of the award letter; and
- preparation of the PPP contract for signature.

c. Direct Appointment

We provide full details of all the steps and stages outlined here in the Annex to Chapter 9 on page 186.

Direct appointment under the 'Specific Conditions'

The stages required for direct appointment under the 'Specific Conditions' are as follows:

- distribution of the RfP to the private entity in question;
- submission of the qualification documents;
- evaluation of the qualification documents;
- submission of the offer;
- evaluation, clarification and negotiation;
- announcement of the result of the direct appointment exercise to obtain the GCA's approval, along with the minutes of the direct appointment evaluation exercise;
- announcement of the contract decision and award; and
- signing of the PPP contract.

Direct appointment in the event of a single pre-qualified bidder

The stages required for direct appointment in the event that there is only one pre-qualified bidder are as follow:

- submission of an invitation to bid to the single pre-qualified company;
- clarification of the details of the PPP project;
- submission of the offer;
- evaluation, clarification and negotiation;
- announcement of the result of the direct appointment exercise to obtain the GCA's approval, along with minutes of the direct appointment evaluation process;
- announcement of the decision and contract award; and
- signing of the PPP contract.

9.4.2 Tendering for an Unsolicited Project

Projects initiated by the private sector (unsolicited projects) must be financially sound and self-standing (i.e. not require government support) and align with existing initiatives in the sector's master plan

As already indicated at the start of this chapter, an unsolicited project is an initiative proposed to the GCA by a private entity wishing to develop an infrastructure project through the PPP mechanism. Such projects must:

- not already appear in the list of projects in the master plan of the relevant development sector;
- be technically coherent with the master plan of the relevant development sector;
- be economically and financially feasible; and
- not require government financial contribution.

In principle, the private entity initiating the project still needs to go through the bidding process in order to become the appointed investor. However, they are entitled to compensation/ favourable treatment as set out in the bidding document. Such compensation/treatment may take the following forms:

'Right to match' allows a project initiator to revise their bid, for example by lowering their price, in order to score highest among the bidders.

- the additional of 10% to their score;
- the right to match, or
- purchase of the initiative by the GCA.

If compensation takes the form of the GCA purchasing the initiative, the project initiator may still participate in the bidding process subject to the following provisions:

- the project initiator signs a letter of confidentiality agreeing not to use or reveal (partially or completely) the initiative for any purpose to any party without the written consent of the GCA;
- the technology offered in the bid must be same as that in the initiative;
- the project initiator does not receive any compensation;
- if the business entities are also consortium members, then the initiator must not withdraw from the consortium within a period of time approved by the GCA; and
- the initiator is willing to buy back the initiative sold to the GCA, if it wins the tender.

Checklist: a private entity initiating an unsolicited project must prepare:	✔
A feasibility study	
A cooperation plan	
A project financing plan, indicating the source of the funding; and	
A cooperation proposal plan, comprising the schedule, process and method of evaluation, as well as the form of compensation selected.	

Figure 9.2: *Checklist of documents required by the initiator of an unsolicited project*

9.4.3 Security Provisions

PPP projects must be underwritten in the form of unconditional bid bonds and project implementation securities issued by appropriate banks.

In principle, according to the current regulations, the securities required in the PPP procurement take the form of bid security and project implementation security. Such guarantees should be issued by a national bank or a foreign bank with a branch in Indonesia. The guarantees must be unconditional and be capable of being triggered within 14 calendar days of a statement of contractual breach being issued by the GCA to the bank.

The amount of the bid security is determined by the characteristics, complexity and risks of the PPP project in question and is set out in, and attached to, the bidding documents. The validity of the bid security runs from submission until one month after the issuing of the contract award letter by the GCA. If required, the winning bidder must extend validity until the signing of the concession agreement.

The level of implementation security provided may be reduced as the project progresses, as set out in the concession agreement.

As regards implementation security, the winning bidder should submit documentation covering this form of security on the date the concession agreement is signed in accordance with the following provisions:

- the level of implementation security during the financial closure period is between 1 and 5% of the value of the investment; and
- the level of implementation security during the construction period is between 1 and 5% of the value of the construction work.

9.5 THE CONTRACT IMPLEMENTATION STAGE

The Special Purpose Company

Private entities must establish a special purpose company (SPC) in order to enter into a cooperation agreement for the establishment of a PPP project.

The winner of the tender exercise must establish an appropriate form of business entity, known as a special purpose company (SPC), to implement the PPP contract. The SPC should be legally established within six months of the issuing of the letter declaring the tender winner or the single winner by the GCA.

Checklist for contract signature:	✔
The GCA and the business entity (in the form of an SPC) sign the PPP contract.	
The PPP contract becomes effective after all the pre-conditions set out in the PPP contract have been fulfilled by all parties. The pre-conditions include the approval of the government guarantee and the obtaining of all necessary permits by the business entity/SPC to carry out its business.	
The financing agreement does not constitute a pre-condition for the entry into force of the PPP contract.	
Once all pre-conditions have been fulfilled, the GCA issues minutes confirming the entry into force of the PPP contract.	

Figure 9.3: *Checklist for the signing of the contract*

9.6 COMMON ISSUES IN PPP TENDERING

The PPP process is a new model for Indonesia, which may throw up some challenges for the government and the procurement committee. Since tendering is such an important element in PPP transactions, we draw attention here to some issues, which the procurement committee, the prospective bidder or project initiator, as well as other stakeholders, need to take into account.

The main point is that PPP procurement is different to regular forms of procurement for works or goods, under which the project owner determines the items needed along with their specifications. Under the PPP procurement model the project owner takes the lead in determining the items to be procured. This is because the aim of the PPP procurement process is to select the best investor to fund, build and operate an infrastructure development. Here, we are talking about private entities potentially wishing to invest in WtE projects. As the main aim of the PPP procurement model is to share risk with the bidder, the involvement of the bidder in determining the technical and financial issues surrounding the project is absolutely essential.

PPP is a relatively new concept in Indonesia. Bidders and members of procurement committees must ensure that they are acquainted with the latest legislation.

Chapter Checklist	✔
Now that you have read this chapter:	
Are you familiar with the legislation governing procurement under PPP schemes in Indonesia?	
Have you the required documents and conditions for pre-qualification?	
Have you the required documents and conditions for bidding?	
Have you the required documents and conditions for contract implementation?	
Are you familiar with the common challenges facing private sector tenderers for PPP projects in Indonesia?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 10

FINANCING AND FINANCIAL MODELS, GUARANTEES AND SENSITIVITY ANALYSIS

WHAT THIS CHAPTER IS ABOUT

In this chapter we examine the likely revenue and expenditure streams associated with waste to energy (WtE) projects.

We look at financial models for assessing the financial viability of prospective WtE projects.

We look at the management, mitigation and sharing of financial risk.

We consider government incentives to encourage investment and private sector involvement and how to apply for them.

We detail the documentation required to apply for financing under public private partnership (PPP) projects and the typical structure of a WtE project under a PPP mechanism.

THE KEY POINTS

- The income generated by WtE projects. *page 146*
- The cost of setting up a WtE project. *page 147*
- How to evaluate the financial viability of a planned WtE project. *page 148*
- What actions are possible to restore a project's viability. *page 153*
- Government financial incentives and how to access them. *page 154*

10.1 WASTE TO ENERGY PROJECTS: POTENTIAL REVENUE STREAMS AND EXPENDITURES

Presidential Regulation 75/2014 categorises waste and energy as priority Infrastructure sectors. It is estimated that Indonesia needs IDR 70 to 100 trillion for infrastructure development over the next five years to achieve 6.6% economic growth. As some estimates put the the capacity of the banking sector, non-banking institutions and the state budget at only around USD 50 billion, private sector participation is vital

Waste and energy are priority infrastructure sectors for Indonesia and may be developed under PPP schemes. Below we consider the possible revenue streams that could be generated by WtE projects and could be used to improve their credit worthiness. We also look at the expenditure required.

Income streams

Tipping Fee

Under Government Regulation No. 81 of 2012 on Management of Household Waste and similar types of Household Waste (GR 81/2012), central and/or local government is required to manage household waste based on an annual funding allocation in the state and local government budgets. This funding can be used to support PPP WtE projects, under which the Government Contracting Agency (GCA) pays the Special Purpose Company (SPC) for the waste management service at the landfill. This tipping fee and all associated matters should be set out in the PPP agreement.

Electricity Sales

The Government of Indonesia (GoI), operating through its Ministry of Energy and Mineral Resources (MEMR), requires the state power company, PT. Perusahaan Listrik Negara (Persero) (PLN), to purchase electricity from power generators producing power from municipal waste under power purchase agreements signed by PLN and the SPC (the feed-in tariff for electricity purchase is based on MEMR Regulation No. 19 of 2013). The obligation of PLN to purchase electricity provides the SPC with revenues, in the form of electricity sales.

The key income streams from WtE projects are the tipping fee and electricity sales.

Other revenues

Depending on the technology used, a waste to energy plant may produce by-products from its operation that could generate additional revenues for the investor or operator, If this is the case, pre-feasibility studies, income projections and financial analyses should take account of these additional revenues.

Expenditure

Capital Expenditure

In addition to the quality and performance of the plant and systems they are purchasing, investors need to take account of three key factors. The first is the daily tonnages of waste that can be managed by the WtE facility (the minimum ideal amount is around 1,000 tonnes per day). The second is the type of WtE technology and infrastructure being used, as this determines capital and operational costs. The third is the scale of the WtE infrastructure project.

The cost of a WtE project generally comprises the capital costs required to design, build and install the equipment, including:

- the initial cost of the equipment, equipment storage, drilling and installation, including import duties and any related taxes;
- design, engineering and administration, including registration and verification fees, and other transaction costs;
- permits and fees, including land acquisition and site preparation, and installation of utilities;
- commissioning.

Operating Expenditure

Operating and maintenance costs are largely determined by the type and quality of the plant and systems installed. Annual operating costs include the gas well, the treatment system and pipelines, and other costs as follows:

Capital expenditure decisions concerning the type of WtE to be installed will affect the level of operating costs required for operation and maintenance.

- materials and spare parts;
- utility costs;
- labour (salaries) and training costs;
- insurance costs;
- administration costs; and
- leasing or rental fees.

In order to ensure that all costs are taken into account, it is suggested that equipment suppliers should be asked to supply quotes for prices on specific pieces of equipment (such as piping, flares and engines) and that these should be factored into the overall financial assessment.

The information on project expenses and revenues becomes part of the input into the financial analysis of each of the project options. Few publicly available financial models are available for this type of analysis. The models and spreadsheets that are available may be suitable for analysis purposes as part of initial screening.

However, a more sophisticated method of financial analysis that carefully evaluates the many considerations outlined in this guidebook is required to determine whether a project is ready for investment, whether internal funds should be committed and whether financial support could be attracted from external parties. Project developers and investors usually carry out a financial evaluation using models specifically matched to the region or country in question, or to the project itself, in order to arrive at a more robust financial analysis.

10.2 FINANCIAL PROJECTION AND FEASIBILITY ANALYSIS

In order to make projections about the financial feasibility of a WtE project, some assumptions have to be made about likely revenue and expenditure scenarios and these in turn are built using a number of financial modelling techniques.

Financial Modelling

Financial models provide a financial representation of a project's likely progress and form a key element of strategy, decision making and performance prediction. The most relevant types of modelling in the context of WtE are described below.

The Revenue Model

We look here at the types of financial models applicable to WtE projects and the components and techniques that underlie them.

Generally speaking, revenue models are based on two variables: price and quantity. This guidebook mainly concerns WtE power plant, revenues from which comprise the tipping fee and electricity sales. This business case provides the basis for developing the revenue model. Each of those revenues has different drivers, suggesting that each should have a separate revenue model. The example of a revenue calculation below is based on the assumptions that the amount of municipal waste is 1,000 tonnes per day and that power plant has a net capacity of 10 MW.

The operating expenditure model

Description	Unit	Amount	Remarks
Tipping fee	**Rp per year**	**109,500,000,000**	**Tipping fee x waste quantity**
Tipping fee	Rp per ton	300,000	Stipulated by the government
Waste quantity	Ton per year	365,000	1,000 ton per day x 365 days per year
Electricity sales	**Rp per year**	**76,212,000,000**	**Feed-in tariff x electricity produced**
Feed-in Tariff	Rp per KWh	1,450*	Governed in MEMR Regulation 19/2013
Electricity produced	KWh	52,560,000	10 MW x 1,000 KW/MW x 365 days per year x 24 hours per day x 60% of capacity factor in the first year
Other revenues	**Rp per year**	**3,790,040,816**	**RDF sales, metal sales, etc** (approximately 2% of total revenues)
Price	Rp per unit	Not assumed	Depend on the market price
Quantity	Unit	Not assumed	Depend on the technology chosen
TOTAL REVENUES	**Rp per year**	**189,502,040,816**	**Tipping fee + electricity sales + other revenues**

**The calculation is based on the old rate in the ESDM Ministerial Decree No. 19/2013. The new tariff is based on the ESDM Ministerial Decree No. 44/2015 can be found on page 102.*

Table 10.1. *Example of a total annual revenues calculation*

As explained in chapter 5, which looks at the various types of WtE technology available, the operating expenditure of a waste-to-energy facility very much depends on the technology chosen. That chapter sets out four options: incineration; gasification; pyrolysis; and refuse-derived fuel (RDF). Each of these options has its own set of specifications due to the fact that each has its own unique technical flow. Such differences affect the selection of the plant and systems installed and, therefore, the associated capital and operating expenditures. Operating expenditure usually falls under three headings: material costs; labour costs; and other costs. This expenditure is treated as a deductible from revenue in order to arrive at a figure for earnings before interest, tax and depreciation expenses (EBITDA).

Depreciation

Capital expenditure under a WtE project is shown as the fixed assets on the balance sheet. After the facility has been built and started operating, the project accountant charges depreciation in order to adjust the book value of the fixed assets as they mature according to their economic life. For example, for fixed assets of Rp 1 trillion with an economic life of 20 years, depreciation would be as much as Rp 50 billion per year (Rp 1 trillion divided by 20 years).

The Ministry of Finance has its own rules regarding asset depreciation which override any internal accounting practices a private sector operator may have.

This expense is not a cash expense, so it will not be recorded in the free cash flow calculations, which was the one used when calculating project feasibility figures. Nonetheless, depreciation has an impact on cash flow, in that it becomes a deductible when calculating the taxable income figure. The Ministry of Finance has its own regulation covering asset depreciation, with the result that a company's own accounting practices would not have any effect on its tax obligations

Working Capital

Working capital is the difference between current assets and current liabilities during normal business operation and therefore affects the SPC's cash flow management. In the case of a WtE, current assets would be in the form of receivables from PLN and the government, and relate to electricity sales and tipping fee respectively. Both parties will delay payments to the SPC because of the way their internal administrations operate; it will take approximately one month from the invoice to the payment actually being made. This suggests that the receivable period is 30 days. On the other hand, current liabilities would come from material suppliers and/or operating expenditures. If, say, the current liabilities period is 7 days, then the SPC would have a working capital period of 23 days (30 days minus 7 days). In other words, the SPC would have to pay its suppliers 21 days earlier than it received cash from its customers. The SPC might want to finance this with either debt/bank loan or equity/own cash.

The cost of borrowing required to acquire, operate and maintain the WtE facility's assets is key to the project's financial viability. We provide a guide to calculating the weighted-average cost of capital.

Cost of Capital

The SPC needs to raise funds in order to finance its assets, both capital expenditure as well as working capital. In normal business practice these funds are provided by the debt holder/lender and equity holder; they share the total financing in the proportion 70% from the lender and 30% from the equity holder, although this figure may vary depending on the lender's appetite for risk. The cost of debt financing depends on the credit rating of the project; at time of writing the cost would be in the range of 10%-15%. A higher rating would drive down the cost of debt. On the other hand, the cost of equity is usually calculated using the capital asset pricing model or CAPM. After both costs have been decided, they can be blended proportionately into what is called the weighted-average cost of capital (WACC). Table 10.2 below shows an example of how we calculate WACC.

Financial Statement Projection

We explain the elements of a financial statement covering a WtE project (income, balance sheet and cash flow) and provide examples of each.

Description	Figure*	Remarks
DEBT		
Debt portion (%D)	70%	Of total assets
Cost of Debt (kd)	13%	Approximate commercial loan interest rate
Tax rate (t)	25%	Indonesia's business tax rate; the tax rate is used since cost of debt is tax deductible
EQUITY		
Equity portion (%E)	30%	Of total assets
Cost of Equity (ke)	17%	Using the CAPM formula: Ke = rf + ß(rm-rf)
Risk-free return (rf)	6%	Return on long-term government bonds
Beta (ß)	1.2	Risk of typical business compared to the market in general; higher than 1 means riskier than the market; 1 means having the same risk as market; lower than 1 suggests a lower risk than the market
Market return (rm)	15%	Return of equity market as an aggregate
WACC	12%	WACC = %D x kd (1-t) + %E x ke

Table 10.2. *Example of calculation of WACC* **figures are rounded to the nearest integers*

Financial statement projections form the basis of strategic planning, helping transform a project's objectives into specific targets, providing a useful feedback and control mechanism and anticipating future problems.

Income Statement

An income statement can be generated on the basis of the revenue model, the expenditure model, depreciation expenses, interest expenses and tax expenses. The top line shows the revenues, while the bottom line is the net income of the project.

Table 10.3 Shows what an income statement might look like in the first three years of operation, assuming that the first two years are taken up with construction. For a fully worked projection, please refer to table 10.10 at the end of this chapter.

Year		2016	2017	2018	2019	2020
INCOME STATEMENT						
Revenues	(a)	-	-	**190**	**208**	**214**
Tipping fee		-	-	110	115	121
Electricity sales		-	-	76	89	89
Other revenues		-	-	4	4	4
Operating expense	(b)	-	-	**57**	**60**	**63**
Material costs		-	-	45	48	50
Labour costs		-	-	5	5	5
Other costs		-	-	7	7	8
EBITDA	(c) = (a) - (b)	-	-	**133**	**148**	**151**
Depreciation expense	(d)	-	-	38	38	38
EBIT (Operating income)	(e) = (c) - (d)	-	-	**95**	**111**	**114**
Interest expense	(f)	-	-	68	63	55
EBIT	(g) = (e) - (f)	-	-	**27**	**48**	**59**
Tax expense	(h)	-	-	7	12	15
Net income	(i) = (g) - (h)	-	-	**20**	**36**	**44**

Table 10.3. *Example of an income statement (Rp billion)*

Balance sheet

This part of financial statement comprises the assets, liabilities and equity. Assets mean everything the project owns, while liabilities and equity show how those assets are being financed. Assets and liabilities are then categorised into (i) current or short-term and (ii) fixed or long-term. Current assets and current liabilities are those maturing within the next 12 month (one year period), whereas fixed assets and long-term liabilities take longer than one year to mature. Unlike liabilities, which mature according to their nature, equity is considered long-term. In the case of WtE projects, the equity matures when the concession period is over.

Cash Flow Statement

Year		2016	2017	2018	2019	2020
BALANCE SHEET						
Assets						
Current assets						
Cash		-	-	5	10	39
Receivables		-	-	16	17	18
Fixed Assets		375	750	713	675	638
Total Assets		**375**	**750**	**733**	**702**	**694**
Liabilities	(a)					
Current liabilities		-	-	1	1	1
Working capital loan		-	-	14	-	-
Long-term debt		263	525	473	420	368
Equity	(b)					
Paid-in capital		113	225	225	225	225
Retained earnings		-	-	20	56	100
Total Liabilities and Equity	(c) = (a) + (b)	**375**	**750**	**733**	**702**	**694**

Table 10.4. *Example of a balance sheet (Rp billion)*

Table 10.4 Shows the balance sheet for the same project, covering assets, liabilities and equity. Table 10.11 at the end of the chapter extrapolates the figures over a 21-year period.

Instead of using cash as the basis for recording transactions, standard accounting practice is to use the accrual basis. This means that not everything recorded in the income statement and the balance sheet relates to cash inflows into, and cash outflows out of, the project. This is why the cash flow statement is so important: it provides a summary of the income statement and balance sheet in cash flow terms, excluding everything that is non-cash. Again, we show an example of this type of report below.

Analysis of project feasibility

Year	2016	2017	2018	2019	2020
CASH FLOW STATEMENT					
Operating activities					
Net income	-	-	20	36	44
Depreciation	-	-	38	38	38

Year		2016	2017	2018	2019	2020
CASH FLOW STATEMENT						
Change in:						
Current assets		-	-	(16)	(2)	(0)
Current liabilities		-	-	1	0	0
CF from operating activities	(a)	**-**	**-**	**43**	**72**	**81**
Investing activities						
Fixed assets		(375)	(375)	-	-	-
CF from investing activities	(b)	**(375)**	**(375)**	**-**	**-**	**-**
Financing activities						
Working capital loan		-	-	14	(14)	-
Long-term debt		263	263	(53)	(53)	(53)
Equity		113	113	-	-	-
CF from financing activities	(c)	**375**	**375**	**(38)**	**(67)**	**(53)**
Change in cash balance	(d)=(a)+ (b)+(c)	-	-	5	5	29
Beginning cash balance		-	-	-	5	10
Ending cash balance		**-**	**-**	**5**	**10**	**39**

Table 10.5. *Example of a cash flow statement (Rp billion)*

Monitoring and control of cash flow is vital for the succesful financial management of a project. An expanded version of the example given here can be found in table 10.12 at the end of the chapter.

No project should be embarked on without a detailed and comprehensive feasilibity study having first been carried out. We go through the steps required to do this.

A feasibility study is used to assess the financial viability and potential of a proposed project, based on detailed analysis and investigation in support of decision making.

How to analyse a project's feasibility

The discounted cash flow method can be used to assess the feasibility of a project. Under this method, all three financial statements (income, balance sheet and cash flow) are used to develop a free cash flow model made up of EBIT (earnings before interest and tax expenses), depreciation expenses and changes in working capital, as well as capital expenditures.

The free cash flow figures are then discounted using weighted-average cost of capital (WACC) in order to arrive at a net present value (NPV). A NPV higher than 0 means the project is feasible; lower means it is not. On the other hand, we can also derive an internal rate of return (IRR) from the free cash flows. When a project's IRR is bigger than its WACC, the project is considered financially feasible. On the other hand, an IRR lower than WACC would hurt the investor, so, in this case, the project would be deemed as not being viable. After NPV and IRR, investors might want to look at the payback period, the time taken for the investor to be paid back fully for their investment. These criteria may be subject to change on a case-by-case basis. Last but not least, the lender may like to see the debt service coverage ratio (DSCR) of the project. This ratio explains how the cash flows of the project are capable of covering the debt obligation. Cash flows are taken from the EBITDA figures, while debt obligation is the principal sum plus periodical interest payments.

Below is an example of project feasibility analysis with a projection of free cash flows for only the first three years of operation (total projection is actually for 20 years according to the period set in the power purchase agreement).

Year		2016	2017	2018	2019	2020
FEASIBILITY ANALYSIS						
EBIT		-	-	95	111	114
Depreciation		-	-	38	38	38
Change in working capital		-	-	(14)	(1)	(0)
Change in fixed assets		(375)	(375)	-	-	-
Free cash flows to the project		(375)	(375)	118	147	151
Accumulated cash flows		(375)	(750)	(632)	(485)	(334)
WACC	12%					
Discount rate		0.95	0.84	0.75	0.67	0.60
PV of FCF to the project		(354.46)	(316.69)	89.16	99.02	90.84
NPV		**362.08**				
Project IRR		**18%**				
Payback period (years)		**8**				
EBITDA		0	0	133	146	151
Debt obligation		0	0	121	116	107
DSCR		0.00	0.00	1.10	1.28	1.41
Average DSCR		**1.88**				
Minimum DSCR		**1.10**				

The figures given in this example indicate a feasible project, satisfying both the investor (with ahead of schedule pay back) and the lender (with cash flows higher than the total debt obligation). For a fully worked set of figures over 21 years, see table 10.13 at the end of the chapter.

Table 10.6. *Example of a project feasibility analysis (Rp billion*

It can be concluded from the figures shown in table 10.6 that the project is feasible. The NPV is higher than zero and the project IRR is higher than the WACC. Assuming that the investor's goal is to be paid back in 10 years, the project can be considered feasible because it pays back before the tenth year. Moreover, from the lender's perspective, the project has cash flows higher than its total debt obligation, giving comfort to the bank in lending its money. Table 10.7 summarises this analysis.

Criteria	Figure	Benchmark	Condition	Conclusion
NPV	Rp 362.08 billion	Rp 0	Higher than benchmark	Feasible
IRR	18%	WACC = 12%	Higher than benchmark	Feasible
Payback period	8 years	10 years	Lower than benchmark	Feasible
Average DSCR	1.88	1.20	Higher than benchmark	Feasible
Minimum DSCR	1.10	1.00	Higher than benchmark	Feasible

Table 10.7. *Summary of a project feasibility analysis*

What if a project is not feasible?

Measures can be taken to restore project feasibility, including decreasing capital expenditure…

If the figures shown against the categories in the table above are not favourable, actions can be taken to render the project feasible. Such actions might range from decreasing capital expenditure (or even increasing capital expenditure to achieve the economic scale required), increasing revenue, lowering operational expenditure, minimising the cost of capital, or even seeking a capital subsidy. The project's financial analyst may want to run a sensitivity analysis to see how different figures based on various assumptions affect feasibility. We next consider each of these possible actions in turn.

Decreasing capital expenditure. The amount of capital expenditure may vary according to what technology is chosen. In today's renewable energy market, many have talked about how costs are decreasing as more advanced production technologies are introduced. Not forgetting the quality of the product, the ability to source a lower project cost might help make the project feasible.

…increasing revenue…

Increasing revenue. As mentioned previously, in WtE there are two kinds of revenue: electricity sales and the tipping fee. The electricity sales figure is calculated by multiplying feed-in tariff and electricity production. Feed-in tariff is a fixed factor; it is regulated by the MEMR and cannot be changed. On the other hand, electricity production could be increased by choosing a more advanced technology or simply by increasing the amount of waste. However, the municipal government may not have decided the amount of the tipping fee at the time the project is being developed. This means that, should the project be less feasible, the tipping fee could be a factor that needs to be adjusted. How the tipping fee is to be calculated is one of the government's main considerations when drawing up the tipping fee regulations. Basically, it depends on two things: the feasibility of the project and the level of the government's commitment and financial capability. In the case of the former, the feasibility of the project is determined by how much the expenditure compares with revenue – this will be explained later in this chapter. In the case of the latter, the government will want to consider its development priorities: if waste management is one of them, then it should support the project, despite its limited financial capability. More often than not, government is constrained by its financial ability to cover the tipping fee annual obligations.

…reducing operating costs…

Lowering operational expenditure. As mentioned above, the advancement of renewable energy technologies is widely known to be able to drive down project costs, including operational costs. The project's technical analyst should assess how recent technologies can maintain output quality (or even increase it) while costing less.

…minimising the cost of borrowing …

Minimising the cost of capital. Capital for an infrastructure project generally comes from two kinds of investors: lenders and equity investors. Both have different risk appetites toward the project. Lenders usually assess not only the project but also the financial strength of the equity holder. Bankable projects would have even cheaper debt costs should the owner be a giant corporation. More flexible and/or cheaper lending products may also be obtainable from a number of development banks or non-banking financial institutions with focus on infrastructure and renewable energy.

…and seeking government financial help.

Seeking a capital subsidy and/or government guarantee. The outcome of the sensitivity analysis may be that the four actions outlined above may not be enough to make the project viable. This is when the government must step in to subsidise the project. The Indonesian government has made a number of efforts to increase the involvement of the private sector and we look at these efforts next.

10.3 INCENTIVES PROVIDED BY THE GOVERNMENT OF INDONESIA

Private sector participation in infrastructure development is vital and the GoI has put policies in place to promote public private partnerships, namely Presidential Regulation (PR) 67/2005, as amended by PR 13/2010, PR 56/2011 and PR 66/2013.

Given the importance of the private sector in accelerating infrastructure development, the government, particularly through its Ministry of Finance, has taken the initiative of providing a wide range of fiscal facilities to encourage private sector involvement in infrastructure development in Indonesia and to improve the attractiveness and competitiveness of PPP programmes. Such facilities include fiscal tools in the form of Government Support and Government Guarantee, applicable to both existing projects and future projects still in preparation.

Government Viability Support

Government Support (Dukungan Pemerintah) may take the form of a fiscal or non-fiscal contribution, given by the GCA and/or the MoF in accordance with their levels of authority, as set out in laws and regulations. Such support is intended to improve the financial feasibility and bankability of PPP projects, as follows:

The Indonesian government recognises the importance of involving the private sector in infrastructure development. Here we look at the types of incentives and support being provided.

- If provided in the form of a fiscal contribution, the Government Support should be included in the relevant state revenue and expenditure budget (Anggaran Pendapatan Belanja Negara) and/or the regional revenue and expenditure budget (Anggaran Pendapatan Belanja Daerah).
- Government Support in the form of licensing, land acquisition, support for 50% of the construction work, and/or any other form of support must be determined by the GCA (e.g. line ministries/head of region).
- The GCA may propose Government Support, such as viability gap funding (VGF) in the form of tax incentives and/or fiscal contributions, to the Minister of Finance. If Government Support is approved, the type of support provided must be stipulated in the tender documents. See figure 10.1 below.
- In addition to the Government Support provisions set out in PR 67/2005 (as amended), MoF Regulation No. 223/PMK.011/2012[1], known as Feasibility Support for Part of Construction Cost or Dukungan Kelayakan atas Sebagian Biaya Konstruksi, also provides an incentive to improve PPP project feasibility. Feasibility Support is paid for by the government through the MoF in its role as the State General Treasurer responsible for the financial capability of the state, fiscal sustainability and fiscal risk management. Feasibility Support may be granted to a PPP project as a last resort, only if there is no other alternative way of improving its financial feasibility.

Government support to improve the financial feasibility and bankability of PPP projects is intended primarily to cover construction costs and is not intended for land acquistion or tax incentives.

Specifically, Feasibility Support should not be spent predominantly on covering construction costs under PPP projects. It may cover items such as equipment costs, installation costs, interest on loans taken out during the construction period, and other costs, but should not cover land acquisition costs or tax incentives.

In the case of a PPP project operated at local level, local government may also contribute to Feasibility Support, if approved by the local parliament. The amount of funding required and the form the contribution is to take may be proposed to the MoF before the pre-qualification stages of the PPP project tender.

PPP projects may receive Feasibility Support amounting to half of the construction cost under the following circumstances:

Government support is dependent on the existence of a comprehensive pre-feasibility study which shows proper risk allocation and clearly indicates that support is required.

- the PPP project has fulfilled the conditions of economic feasibility, but is not financially feasible;
- the PPP project is based on the 'customer pays' principle;
- the investment value of the PPP project is not less than IDR 100,000.000 (one hundred billion rupiahs);
- the PPP project is being implemented by a business entity that has signed a cooperation agreement provided by GCA on the basis of a public, competitive tender in accordance with the regulations on Cooperation of Government and Business Entities for Provision of Infrastructure;

[1] *Article 5, MOF Regulation No. 223/PMK.011/2012 concerning Granting of Feasibility Support for Half of Construction Cost in the Cooperation Project of Government with Business Entity for Provision of Infrastructure*

- the PPP project is being implemented on the basis of a cooperation agreement governing the way in which assets will be transferred and/or managed from the business entity to the GCA at the end of the cooperation agreement;
- the pre-feasibility study: (i) allocates risk optimally between the government/GCA, on the one side and the business entity signing the cooperation agreement on the other; (ii) shows that the PPP project is economically feasible and takes account of all technical, legal, environmental and social aspects; and (iii) shows that the PPP project will become feasible, if it receives Feasibility Support.

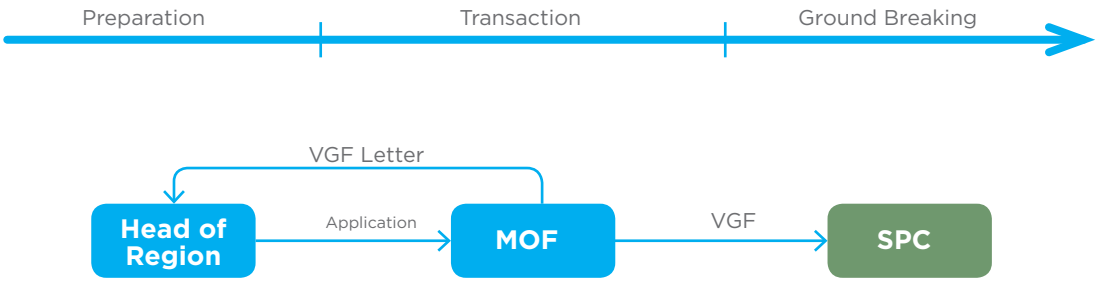


Figure 10.1: *The viability gap funding process in brief*

The IIGF is able to provide government guarantees in support of PPP projects, if the cooperation agreement between the private company and the GCA meets all requirements in terms of risk allocation and mitigation, financial responsibilities and dispute resolution.

Government Guarantee

In general, government guarantees for PPP projects are governed under Article 17B of PR 67/2005. In the case of PPP projects, Government Guarantee means financial compensation and/or compensation in any other form, given by the MoF to a business entity under a risk allocation scheme drawn up for the project. In addition, Government Guarantees for PPP projects are further regulated by the GoI under PR 78/2010 and through the establishment of the Indonesia Infrastructure Guarantee Fund (IIGF or PT. Penjaminan Infrastruktur Indonesia), a state-owned company set up to provide guarantees for PPP infrastructure projects.

The IIGF is able to provide a Government Guarantee, so long as the cooperation agreement to implement the PPP project provides that:

- the risk is shared between the parties;
- there are proper efforts at mitigation carried out by the parties to prevent risks arising and to reduce their effects, if they do occur;
- the amount of financial obligation to be borne by the GCA in terms of infrastructure risk, the responsibility of GCA or the formulation to be used to determine amount of financial obligation were not known at the time the cooperation agreement was signed by the parties;
- there is sufficient time to implement the financial obligations of the GCA, including any grace period;
- there is a reasonable procedure in place to determine the timing of GCA's financial obligations in the case of insolvency;
- there is a dispute resolution procedure in place (preferably based on alternative dispute settlement and/or arbitration) to settle any issues which may arise between GCA and the business entity in relation to the implementation of GCA's financial obligation; and
- the prevailing law is the law of the Republic of Indonesia.

The IIGF not only evaluates and authorises applications for government guarantees, the fund also provides support and guidance to applicants and helps to resolve any issues that may arise.

In addition to the above, the GCA may receive a guarantee from the IIGF once the GCA has issued a letter stating the validity of the cooperation agreement and has provided a written commitment to the guarantor (IIGF) that it will:

- to the best of its abilities, control, manage, prevent and reduce the impact of risk to the infrastructure project for which it is responsible, in accordance with the allocation of risk set out in the cooperation agreement during the validity of the guarantee agreement;
- fulfil the obligations set out in the agreement with IIGF.

We look here at the four steps required by the IIGF before it will issue a government guarantee.

In accordance with the IIGF Guidelines for providing Government Guarantees (March 2012 edition), the IIGF must take the following four steps before providing a guarantee:

- consultation and guidance;
- screening;
- evaluation; and
- structuring.

We look at each of these steps below.

Consultation and guidance

In this phase, the IIGF provides detailed information to the GCA about guarantees (e.g. the guarantee criteria and the process required to obtain the guarantee). Ideally, consultation and guidance is conducted in the preliminary stage of a PPP project prior to mobilisation of experts for preparation of the project.

Screening

In this phase, the GCA submits a screening form to the IIGF. The IIGF evaluates the screening form and, if it passes preliminary screening, IIGF issues confirmation to proceed to the GCA. If the evaluation of the screening form is not satisfactory, the IIGF advises the GCA to modify the PPP project's implementation plan accordingly. After confirmation to proceed has been issued, the IIGF provides assistance to the GCA in completing the guarantee proposal. The guarantee proposal comprises at least:

- the application letter from the GCA to IIGF;
- the pre-feasibility study;
- the PPP structure;
- the risk allocation matrix and risk mitigation plan;
- the draft cooperation agreement;
- the government support required;
- the request for guarantee coverage;
- the projected cash flow (in the form of a spreadsheet);
- the environmental and social feasibility assessment;
- the project management plan, including procurement plan;
- information in relation to the GCA.

The IIGF ensures that the guarantee proposal submitted by the GCA fulfils all the items required in the preliminary checklist (as listed above). If this is not the case, the IIGF informs the GCA and provides suggestions to address the issues.

Evaluation

In this phase, the IIGF evaluates the PPP project in detail, from the legal, technical, economic and financial points of view, taking account of environmental and social considerations, including the ability of the GCA to fulfil its financial obligations in accordance with the cooperation agreement. The evaluation criteria used are set out in the table below:

This table lists the evaluation criteria applied by the IIGF when screening applications for Government Guarantees, including the project's viability, risk management, attractivess to investors and the capacity of the GCA.

If the amount of the guarantee falls within th e capital capability of the IIGF, then the IIGF may decide to provide the guarantee itself. If the amount falls outside its capital capability, the IIGF may decide to involve a co-guarantor to guarantee the project.

Aspect	Document/ supporting information	Basis and description of the appraisal
Relating to feasibility		
Technical, financial and economic analysis	Pre-feasibility study, cash-flow projection	Project can be implemented from the technical point of view, satisfies economic and social returns (possibly receiving government support). Methodology, assumption and collection of realistic data without bias, accurate and comprehensive, generally requiring the involvement of credible experts.
Social and environmental compliance	Environmental and social impact (EIA)	Identification of project impact on the environment and society, including the impact mitigation plan.
Government support	Description of government support	If the PPP project requires government support directly to achieve feasibility, the form of such direct support must be stipulated.
Relating to risk		
Management of risk	PPP structure, cooperation agreement, risk matrix and mitigation plan	Comprehensive identification of risk allocation satisfying best practice principles, appropriate mitigation plan, accurate PPP structure and clear provision regarding allocation of risk in the cooperation agreement.
Guarantee coverage	Guarantee coverage, cover letter	Based on MoF Regulation 260/2010, relating to structure and PPP agreement, and to risk matrix, detailed guarantee coverage requested by IIGF.
Relating to securing investment		
Procurement of an investor	Procurement plan	The quality of procurement is determined by the success of the project in securing a credible investor. This provision must also satisfy requirements of PR 67/2005 (as amended).
Relating to the capacity of the GCA		
GCA capacity	Information related to the GCA	Determined by the level of control of the GCA over the risk identified. The GCA must declare its risk mitigation plan, plus any agreement with other parties, including other public institutions at local or central level. In addition, the IIGF assesses the financial capability of the GCA to fulfil its financial obligations and, if required, the availability of fiscal support from the MoF, with all such provisions being provided.

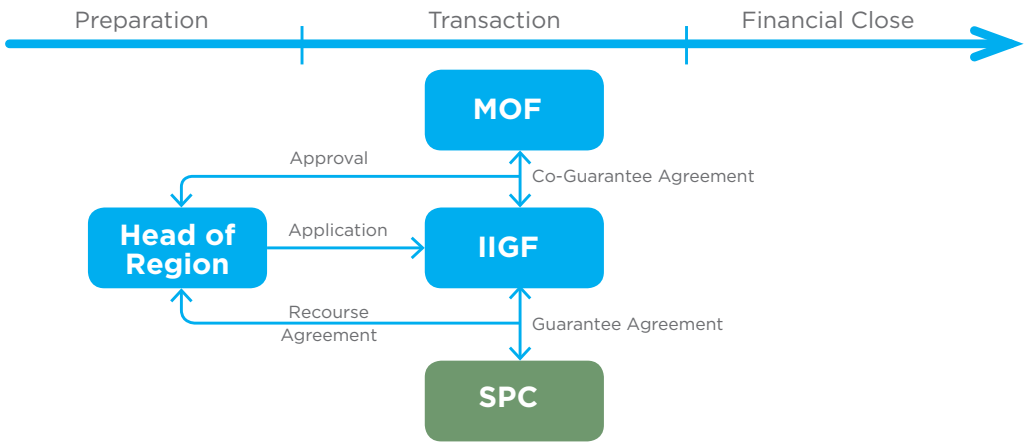
Table 10.8: *The evaluation criteria for the Guarantee Fund.*

Furthermore, the IIGF will also consider the guarantee period proposed by the GCA. The guarantee period may be: (i) during, or part of, the project preparation period; (ii) during, or part of, the project construction period; and/or (iii) during, or part of, the project operation period. If the IIGF's assessment is that the project is worth guaranteeing, then the IIGF issues the Letter of Intent. However, the final confirmation of the guarantee is given in the structuring phase.

Structuring

In this phase the IIGF determines the structure of the guarantee, including preparing the provisions of the guarantee (e.g. the term of guarantee, risk coverage and financial obligations); these are drawn up and adjusted specifically for each PPP project. As final confirmation, IIGF will issue an In Principle Approval, which provides the following information, as required under PR 78/2010:

- the amount of the guarantee;
- the risk coverage (including description of exceptions, if any); and
- the period of the guarantee.



The regulations governing PPP arrangements allow for private sector involvement in building and operating waste treatment facilities but make no provision for private companies to collect or transport waste or to collect tariffs.

Figure 10.2: *The Government Guarantee process*

In summary, the conceptual differences between Government Support and Government Guarantee can be described in the table below.

We summarise here the main differences between government support and government guarantee.

Government Support	Government Guarantee
Provided , if the PPP project is economically feasible, but lacks sufficient funding.	
	Provided, if there is political risk relating to the continuity of the project.
Supports financial feasibility.	Mitigates the concerns of the private sector or lenders in the transaction, the government/the GCA, as the owners of the project, carrying the sovereign risk.
Support can be in the form of licensing, land acquisition, incentives, specific tasks or fiscal contributions, as permitted under the regulations.	Takes the form of financial compensation through the Ministry of Finance.
The Minister of Finance may provide approval for provision of support through tax incentives and fiscal contributions in response to proposals put forward by the relevant ministry/head of the regional government.	Given through the Infrastructure Guarantor Company (PT Penjamin Infrastruktur –PII). The PII ringfences the State Revenues and Expenditures Budget (Anggaran Pendapatan Belanja Negara –APBN), based on the liabilities arising from the guarantee. Risk assessment and the process of granting the guarantee to the investor are undertaken professionally and with certainty.

Table 10.9: *The key concepts of Government Support and Government Guarantee*

10.4 PROJECT STRUCTURE AND DOCUMENTATION

Project Structure

Under PPP regulations a private company (SPC) can be involved in building and operating a waste treatment facility at a final disposal facility but is usually not involved in waste collection or the retail tariff collection. The policy governing PPP provides scope for transportation of waste to be included in cooperation agreements with the private sector, but such measures have not been included in the scope of the regulations governing PPP arrangements.

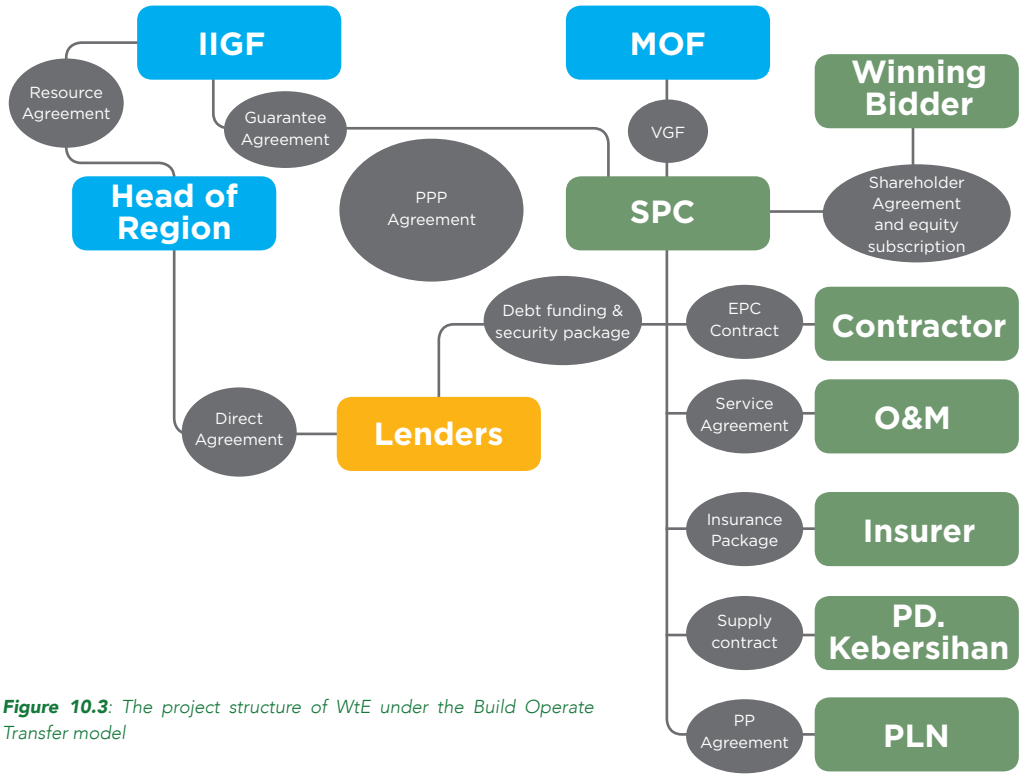


Figure 10.3*: The project structure of WtE under the Build Operate Transfer model*

At the end of the Build Operate Transfer (BOT) contract period, the ownership of the final disposal facility is handed to the GCA, which may continue to operate the facility until the end of the asset's life. The regional government as the CA (usually as the waste supplier which collects from the retail customers and other locations) pays a tipping fee for the service provided by the private company either in transporting waste and through the final disposal facility in the form of the tipping fee. Depending on the technology used in the project, the output from the process carried out by the private company can be used or sold to generate additional revenue to the private company (e.g. in the form of electricity sold to the PLN state utility company or sales of processed products, such as compost or brick).

Project Documentation

The various documents typically used to arrange financing of WtE projects in Indonesia are described here briefly. They are the shareholder agreement and equity subscription agreement…

The following are brief descriptions of the documents related to the financing of WtE projects typically used in Indonesia:

Shareholder agreement and equity subscription agreement

The winning bidder must establish an SPC within 6 months of being identified as the winner by the GCA. A mandatory provision of PPP regulations prohibits shareholders from transferring their shares to other parties before the WtE is in commercial operation. A further provision is that the shareholder agreement should comply with Indonesian Company Law. In the Equity Subscription Agreement, the parties should subscribe equity in line with the debt against equity ratio stipulated in the request for proposal (RFP) document.

PPP agreement

…the PPP agreement between the GCA and the private sector company …

The PPP agreement sets out the rights and obligations of the GCA and the SPC in the development and operation of the PPP WtE project. One of the obligations strictly stipulated under a PPP agreement is that the SPC must obtain financing for the project no later than 12 months after the PPP agreement is signed. Typically, the PPP agreement also stipulates the debt ratio that the SPC is allowed to obtain. The size of the ratio is subject to negotiation among the parties.

Under the PPP agreement, the SPC is prohibited from taking out security against the project's assets, except for the facility and the equipment as part of the facility, and the revenues of the SPC from the operation and maintenance of the project. The GCA must give its prior approval before security is taken out.

The PPP agreement also stipulates the step-in-rights rights and responsibilities of the lender within step-in period. The PPP agreement for WtE projects also sets the amount of tipping fee and the payment mechanism, including the adjustment to the tipping fee annually or at any other time as agreed by the parties.

Direct agreement

…the direct agreement between the GCA and the lender…

If the PPP agreement includes step-in-rights under the project, the lender will typically make a direct agreement with the GCA to set out the terms and conditions under which step-in-rights can be enforced by the lender to the project.

…the guarantee and recourse agreement between the IIGF and the private sector company…

Guarantee agreement and recourse agreement

The Government Guarantee and financial compensation are provided by the MoF through the IIGF. The guarantee agreement is an agreement between the IIGF and the SPC. It contains the following minimum provisions:

- the guarantee is agreed between the guarantor and the parties benefiting from the guarantee;
- a procedure is provided showing how the guarantor's obligations are to be implemented;
- the procedure for dispute settlement; and
- the prevailing law is Indonesian Law.

The recourse agreement is made between the GCA and the guarantor (IIGF). The main provision of the recourse agreement is the payment mechanism covering the obligation between the GCA and the IIGF.

…the loan agreement and security package between the lender and the private sector company…

Loan agreement and security package

The loan agreement made between the lender and the SPC must be in line with the PPP agreement (e.g. the debt and equity ratio). Every loan agreement, involving either project or corporate financing, must contain conditions covering the initial disbursement. The following are conditions commonly placed by lenders on borrowers in project financing:

- transaction documents must be signed;
- borrower certificates are required;
- security documents are signed;
- the borrower has obtained the required authorisations;
- legal opinion is provided;
- there is an auditor's certificate;
- insurance is in place;
- the necessary fees have been paid;
- other fees, costs, and expenses and been paid;
- environmental matters have been taken into account;
- an account has been established;
- project documents are complete and effective;
- reporting obligations are fulfilled;
- Indonesian language is the accepted language; and
- searches have been conducted.

The SPC may only conclude a financial agreement once it has fulfilled the conditions for the initial disbursement of the loan. In addition, the SPC's ability to take out security against the project's assets is limited, with the result that the SPC can only take out security against permitted assets, such as facilities (support facilities) or equipment. Under Indonesian law, the SPC may create fiducia (collateral) security over the facilities or equipment assets. The fiducia security requires a deed of fiducia and registration at the fiducia office to make the security effective. Regarding the revenues generated under the project, the SPC may draw up a document pledging the security of the project's revenue account. This pledge is taken as having been made, and having become effective, when the deed of pledge is signed between the borrower and lender.

...the engineering. procurement and construction agreement between the private sector company and the contractor...

Engineering, procurement, construction (EPC) agreement

The EPC agreement made between the SPC and the contractor must be in line with the timing requirements set out in the PPP agreement. If the timing of the EPC agreement does

not match the PPP agreement and leads to a default situation, this has a very large impact on financing. The SPC may ask the contractor for a performance guarantee to make sure the contractor complies with the provisions set out in the EPC agreement.

Operations and maintenance (O&M) agreement

...the operations and maintenance (O&M) agreement between the private sector company and the O&M contractor...

The O&M agreement made between the SPC and the O&M contractor must be in line with the quality levels and standards specified in the PPP agreement. The SPC must ensure that the O&M operator will not take the SPC into a default situation, as specified under the PPP agreement. This warranty is typically made by the SPC as part of the loan agreement with the lender.

Feedstock agreement

...the feedstock agreement between the private sector company and the GCA...

Typically, the feedstock agreement is made between the SPC and the GCA. The GCA may also enter into another agreement with an appointed government unit for waste transport or supply. The feedstock agreement also governs the tipping fee to be paid by the GCA/ government to the SPC for waste management services at the landfill. This tipping fee is the obligation of the GCA and should be stated in the PPP agreement.

The SPC should ensure that the supplier supplies the required amount of waste every day. This obligation may impact on the performance obligations of the SPC as set out in the PPP agreement and also on the guarantees, covenants and warranties set out in the loan agreement.

Power purchase agreement

...and the power purchase agreement between the private sector company and the state-owned power company.

Ideally, the power purchase agreement should be signed before the loan agreement. The power purchase agreement is a key document, giving the lender an idea of the revenue to be generated by the project. The lender should also undertake a due diligence examination of the power purchase agreement to ensure that there is no financial covenant that may impact on the financing of the project.

The power purchase agreement is typically made between PLN and the SPC. The power purchase agreement sets out, amongst other things, the rights and obligations of the parties, the price of the power being purchased, the method of payment and the sanctions to be imposed, if SPC delays installation. No adjustments are possible in the power purchase tariffs, unless there is an increase or change in the US Dollar/rupiah exchange rate and/ or a change in gas prices. If the change is more than 6% percent, then the parties should renegotiate the prices contained in the agreement.

Table 10.10: *Example of a project's income statement (Rp billion)*

Inflation		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Cash flow period		0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5
COD period		0	0	1	2	3	4	5	6	7	8	9
Year		**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
INCOME STATEMENT (in IDR bio)												
Revenues	**(a)**	**-**	**-**	**190**	**208**	**214**	**220**	**227**	**233**	**240**	**248**	**256**
Tipping fee		-	-	110	115	121	127	133	140	147	154	162
Electricity sales		-	-	76	89	89	89	89	89	89	89	89
Other revenues		-	-	4	4	4	4	5	5	5	5	5
Operating expense	**(b)**	**-**	**-**	**57**	**60**	**63**	**66**	**69**	**73**	**76**	**80**	**84**
Material costs		-	-	45	48	50	53	55	58	61	64	67
Labor costs		-	-	5	5	5	5	6	6	6	6	7
Other costs		-	-	7	7	8	8	8	9	9	10	10
EBITDA	**(c) = (a) - (b)**	**-**	**-**	**133**	**148**	**151**	**154**	**157**	**161**	**164**	**168**	**172**
Depreciation expense	**(d)**	-	-	38	38	38	38	38	38	38	38	38
EBIT (Operating income)	**(e) = (c) – (d)**	**-**	**-**	**95**	**111**	**114**	**117**	**120**	**123**	**127**	**130**	**134**
Interest expense	**(f)**	-	-	68	63	55	48	41	34	27	20	14
EBT	**(g) = (e) – (f)**	**-**	**-**	**27**	**48**	**59**	**69**	**79**	**89**	**99**	**110**	**121**
Tax expense	**(h)**	-	-	7	12	15	17	20	22	25	27	30
Net income	**(i) = (g) – (h)**	**-**	**-**	**20**	**36**	**44**	**52**	**59**	**67**	**75**	**82**	**91**

Inflation		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Cash flow period		11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5
COD period		10	11	12	13	14	15	16	17	18	19	20
Year		**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
INCOME STATEMENT (in IDR bio)												
Revenues	**(a)**	**264**	**273**	**282**	**291**	**301**	**312**	**323**	**335**	**347**	**360**	**373**
Tipping fee		170	178	187	197	206	217	228	239	251	264	277
Electricity sales		89	89	89	89	89	89	89	89	89	89	89
Other revenues		5	5	6	6	6	6	6	7	7	7	7
Operating expense	**(b)**	**88**	**93**	**97**	**102**	**107**	**113**	**118**	**124**	**130**	**137**	**144**
Material costs		71	74	78	82	86	90	95	99	104	109	115
Labor costs		7	7	8	8	9	9	9	10	10	11	11
Other costs		11	11	12	12	13	14	14	15	16	16	17
EBITDA	**(c) = (a) - (b)**	**176**	**180**	**185**	**189**	**194**	**199**	**205**	**211**	**217**	**223**	**229**
Depreciation expense	**(d)**	38	38	38	38	38	38	38	38	38	38	38
EBIT (Operating income)	**(e) = (c) – (d)**	**138**	**143**	**147**	**152**	**157**	**162**	**167**	**173**	**179**	**185**	**192**
Interest expense	**(f)**	7	-	-	-	-	-	-	-	-	-	-
EBT	**(g) = (e) – (f)**	**132**	**143**	**147**	**152**	**157**	**162**	**167**	**173**	**179**	**185**	**192**
Tax expense	**(h)**	33	36	37	38	39	40	42	43	45	46	48
Net income	**(i) = (g) – (h)**	**99**	**107**	**110**	**114**	**118**	**121**	**125**	**130**	**134**	**139**	**144**

Table 10.11: *Example of a project's balance sheet (Rp billion)*

Inflation	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Cash flow period	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5
COD period	0	0	1	2	3	4	5	6	7	8	9
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
BALANCE SHEET (in IDR bio)											
Assets											
Current assets											
Cash	-	-	5	10	39	75	119	170	229	296	371
Receivables	-	-	16	17	18	18	19	19	20	20	21
Fixed Assets	375	750	713	675	638	600	563	525	488	450	413
Total Assets	**375**	**750**	**733**	**702**	**694**	**693**	**700**	**714**	**737**	**767**	**805**
Liabilities **(a)**											
Current liabilities	-	-	1	1	1	1	1	1	1	2	2
Working capital loan	-	-	14	-	-	-	-	-	-	-	-
Long-term debt	263	525	473	420	368	315	263	210	158	105	53
Equity **(b)**											
Paid-in capital	113	225	225	225	225	225	225	225	225	225	225
Retained earnings	-	-	20	56	100	152	211	278	353	435	526
Total Liabilities and Equity **(c) = (a) + (b)**	**375**	**750**	**733**	**702**	**694**	**693**	**700**	**714**	**737**	**767**	**805**

Inflation	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Cash flow period	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5
COD period	10	11	12	13	14	15	16	17	18	19	20
Year	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
BALANCE SHEET (in IDR bio)											
Assets											
Current assets											
Cash	454	598	745	896	1,050	1,208	1,371	1,537	1,708	1,883	2,064
Receivables	22	22	23	24	25	26	27	28	29	30	31
Fixed Assets	375	338	300	263	225	188	150	113	75	38	-
Total Assets	**851**	**958**	**1,068**	**1,182**	**1,300**	**1,422**	**1,547**	**1,677**	**1,811**	**1,951**	**2,095**
Liabilities **(a)**											
Current liabilities	2	2	2	2	2	2	2	2	2	3	3
Working capital loan	-	-	-	-	-	-	-	-	-	-	-
Long-term debt	-	-	-	-	-	-	-	-	-	-	-
Equity **(b)**											
Paid-in capital	225	225	225	225	225	225	225	225	225	225	225
Retained earnings	624	731	842	955	1,073	1,194	1,320	1,450	1,584	1,723	1,867
Total Liabilities and Equity **(c) = (a) + (b)**	**851**	**958**	**1,068**	**1,182**	**1,300**	**1,422**	**1,547**	**1,677**	**1,811**	**1,951**	**2,095**

Table 10.12: *Example of a project's cash flow statement (Rp billion)*

Inflation		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Cash flow period		0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5
COD period		0	0	1	2	3	4	5	6	7	8	9
Year		**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
CASH FLOW STATEMENT (in IDR bio)												
Operating activities												
Net income		-	-	20	36	44	52	59	67	75	82	91
Depreciation		-	-	38	38	38	38	38	38	38	38	38
Change in:												
Current assets		-	-	(16)	(2)	(0)	(1)	(1)	(1)	(1)	(1)	(1)
Current liabilities		-	-	1	0	0	0	0	0	0	0	0
CF from operating activities	**(a)**	**-**	**-**	**43**	**72**	**81**	**89**	**96**	**104**	**112**	**119**	**127**
Investing activities												
Fixed assets		(375)	(375)	-	-	-	-	-	-	-	-	-
CF from investing activities	**(b)**	**(375)**	**(375)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Financing activities												
Working capital loan		-	-	14	(14)	-	-	-	-	-	-	-
Long-term debt		263	263	(53)	(53)	(53)	(53)	(53)	(53)	(53)	(53)	(53)
Equity		113	113	-	-	-	-	-	-	-	-	-
CF from financing activities	**(c)**	**375**	**375**	**(38)**	**(67)**	**(53)**	**(53)**	**(53)**	**(53)**	**(53)**	**(53)**	**(53)**
Change in cash balance	**(d)=(a)+(b)+(c)**	-	-	5	5	29	36	44	51	59	67	75
Beginning cash balance		-	-	-	5	10	39	75	119	170	229	296
Ending cash balance		**-**	**-**	**5**	**10**	**39**	**75**	**119**	**170**	**229**	**296**	**371**

Continuation of Table 10.12.

Inflation		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Cash flow period		11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5
COD period		10	11	12	13	14	15	16	17	18	19	20
Year		**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
CASH FLOW STATEMENT (in IDR bio)												
Operating activities												
Net income		99	107	110	114	118	121	125	130	134	139	144
Depreciation		38	38	38	38	38	38	38	38	38	38	38
Change in:												
Current assets		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Current liabilities		0	0	0	0	0	0	0	0	0	0	0
CF from operating activities	**(a)**	**136**	**144**	**147**	**151**	**154**	**158**	**162**	**166**	**171**	**176**	**180**
Investing activities												
Fixed assets		-	-	-	-	-	-	-	-	-	-	-
CF from investing activities	**(b)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Financing activities												
Working capital loan		-	-	-	-	-	-	-	-	-	-	-
Long-term debt		(53)	-	-	-	-	-	-	-	-	-	-
Equity		-	-	-	-	-	-	-	-	-	-	-
CF from financing activities	**(c)**	**(53)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Change in cash balance	**(d)=(a)+(b)+(c)**	83	144	147	151	154	158	162	166	171	176	180
Beginning cash balance		371	454	598	745	896	1,050	1,208	1,371	1,537	1,708	1,883
Ending cash balance		**454**	**598**	**745**	**896**	**1,050**	**,208**	**,371**	**1,537**	**1,708**	**1,883**	**2,064**

Table 10.13: *Example of a project's feasibility analysis (Rp billion)*

Inflation		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Cash flow period		0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5
COD period		0	0	1	2	3	4	5	6	7	8	9
Year		**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
FEASIBILITY ANALYSIS (in IDR bio)												
EBIT		-	-	95	111	114	117	120	123	127	130	134
Depreciation		-	-	38	38	38	38	38	38	38	38	38
Change in working capital		-	-	(14)	(1)	(0)	(0)	(0)	(0)	(1)	(1)	(1)
Change in fixed assets		(375)	(375)	-	-	-	-	-	-	-	-	-
Free cash flows to the project		(375)	(375)	118	147	151	154	157	160	164	167	171
Accumulated cash flows		(375)	(750)	(632)	(485)	(334)	(180)	(23)	137	301	468	639
WACC	12%											
Discount rate		0.95	0.84	0.75	0.67	0.60	0.54	0.48	0.43	0.38	0.34	0.31
PV of FCF to the project		(354.46)	(316.69)	89.16	99.02	90.84	82.78	75.47	68.86	62.85	57.41	52.47
NPV		**362.08**										
Project IRR		18%										
Payback period (years)												
EBITDA		0	0	133	148	151	154	157	161	164	168	172
Debt obligation		0	0	121	116	107	100	93	87	80	73	66
DSCR		0.00	0.00	1.10	1.28	1.41	1.54	1.68	1.86	2.06	2.30	2.60
Average DSCR		**1.88**										
Minimum DSCR		**1.10**										
Free cash flows to the project		-375	-375	118	147	151	154	157	160	164	167	171
CF from/to debt holder		263	263	-121	-116	-107	-100	-93	-87	-80	-73	-66
CF from/to equity holder		-113	-113	-3	31	44	54	64	74	84	94	105
Equity IRR		**24%**										

Continuation of Table 10.13.

Inflation		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Cash flow period		11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5
COD period		10	11	12	13	14	15	16	17	18	19	20
Year		**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
FEASIBILITY ANALYSIS (in IDR bio)												
EBIT		138	143	147	152	157	162	167	173	179	185	192
Depreciation		38	38	38	38	38	38	38	38	38	38	38
Change in working capital		(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Change in fixed assets		-	-	-	-	-	-	-	-	-	-	-
Free cash flows to the project		175	180	184	189	193	199	204	210	216	222	228
Accumulated cash flows		815	994	1,178	1,367	1,560	1,759	1,963	2,173	2,388	2,610	2,838
WACC	12%											
Discount rate		0.27	0.24	0.22	0.20	0.17	0.16	0.14	0.12	0.11	0.10	0.09
PV of FCF to the project		47.98	43.90	40.19	36.82	33.75	30.96	28.41	26.09	23.97	22.04	20.27
NPV												
Project IRR												
Payback period (years)												
EBITDA		176	180	185	189	194	199	205	211	217	223	229
Debt obligation		59	0	0	0	0	0	0	0	0	0	0
DSCR		2.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average DSCR												
Minimum DSCR												
Free cash flows to the project		175	180	184	189	193	199	204	210	216	222	228
CF from/to debt holder		-59	0	0	0	0	0	0	0	0	0	0
CF from/to equity holder		116	180	184	189	193	199	204	210	216	222	228
Equity IRR												

Chapter Checklist	✔
Now that you have read this chapter:	
Have you calculated the potential cost of your WtE project and projected the likely levels of income it will generate?	
Have you fully assessed the financial viability of the project?	
Are you aware of the government support available for project financing and how to access it?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 11

OPERATING A LANDFILL GAS WASTE TO ENERGY FACILITY

WHAT THIS CHAPTER IS ABOUT

In this chapter we consider the benefits of private sector involvement in waste to energy (WtE) schemes under public private partnership (PPP) mechanisms.

We examine how to staff WtE facilities efficiently, using the example of a 12 MW project plant already operating in Indonesia.

We describe the monitoring and maintenance regimes required for safe, effective, and environmentally and socially responsible operation.

THE KEY POINTS

- The benefits of involving the private sector in the operation of waste to energy plants in Indonesia. *page 172*
- Staffing WtE facilities efficiently in terms of numbers, know how and experience, and the allocation of roles and responsibilities. *page 172*
- The plant monitoring and maintenance regimes required. *page 175*

11.1 ENGAGING THE PRIVATE SECTOR

We focus now on the operation and management of waste to energy (WtE) projects, with particular emphasis on operation and management by a private sector operator under a PPP mechanism. Other sections of this guidebook cover contracting arrangements; here we look in more detail at the staffing and logistical arrangements required to run the project.

Using a private sector company to design and operate a WtE project can bring many advantages for the local government responsible for waste disposal. A well drafted PPP agreement will ensure that the landfill and WtE facility are operating efficiently and in the best interests of the local community.

Although a local government (LG) can run a WtE project, there are advantages to engaging a private sector operator:

- they bring in specialist technical knowledge and experience not available to the LG;
- the aim of the project is to operate as a profit making enterprise – this goes against LG standards and LGs cannot hold second accounts;
- the drive for profit promotes high generator availability and efficient operation, consequently maximising the benefits to the LG and to the environment; and
- private sector partners are able to bring in equipment and spare parts much more quickly than if they had to be purchased through the normal LG procurement channels.

A well-constructed PPP agreement means that the LG is still able to ensure that the landfill site and WtE facility are being properly run and maintained in the best interests of the local community and are adhering to all environmental and safety standards. The LG should engage an independent technical specialist to monitor project activity and ensure all the requirements of the PPP agreement are being met.

11.2 STAFFING

The on-going development and operation of an LFG to power scheme requires a broad range of skills and knowledge and very close coordination between all areas. Operators could have

different approaches to the overall management and resourcing of the specific areas, which may include:

- separate teams for power house and gas field operations
- integration of all activities within the same team;
- contracting out gas field modifications and extensions;
- contracting out all or some of the generator maintenance activities; and
- no permanent site presence (small landfills or closed sites only).

Using a single team to operate the WtE facility encourages team working and ownership, and avoids a blame culture, if things go wrong.

Provided the skills are available, or can be developed, there are advantages to operating a single team with responsibility for gas collection and power generation, the members of which are working to a common goal and are directly responsible for the consequences of their actions. This approach provides less opportunity for disharmony between individual teams and the tendency for one team to 'blame' the other for poor performance.

Whichever approach is taken, a single responsible project manager (PM), generally an engineer, must oversee the project. The PM must ensure that all activities are co-ordinated effectively and must have sufficient knowledge of the whole system to understand the issues and resolve problems. Where the project is on an active landfill, a knowledge of the landfill design and operation process is important to ensure that there are no adverse impacts of one activity on another. The landfill environment often produces problems requiring novel and unique solutions. The PM must also ensure that staff can carry out the work they are required to perform and, in particular, are trained in safe working practices when dealing with gas. The PM also needs to prepare the annual budget, manage expenditure and ensure that the project is operating as safely and as efficiently as possible.

The role of the project manager is paramount in running a successful project. Management of the landfill and management of the LFG power plant are intrinsically linked.

Factors Influencing Staffing Levels

Effective staffing levels are driven by a number of factors, including, inter alia:

- the physical size of the project – a large landfill with many gas wells requires much more time for monitoring, adjustment and overall inspection and maintenance;
- the rate of waste input and, therefore, the potential rate of growth of the gas collection system and generating plant;
- the number of power units;
- whether the landfill is closed or open, whether the gas collection is only from closed cells or also from operating areas;
- the extent of cooperation and coordination with landfill operations – poor coordination or cooperation can lead to considerable amounts of time being spent dealing with repeated movement of pipework, recovering from infrastructure losses, overcoming flooded gas wells, last minute alterations to systems and many other problems;
- the availability of skilled staff; and
- the choice of technology – landfill gas generation technology has developed considerably and selection of technology with a good track record can reduce maintenance and manning requirements significantly

Staffing levels vary from site to site and depend on project size. The large differences in staffing levels between Indonesia and the UK are explained by the relative maturity of the industry in the UK, the skill sets available, the technology used and the well developed regulatory environment.

Needless to say, manning levels are very site-specific. The following section details the staffing levels of a large Indonesian project where a total of 60 staff are employed to run a project of

approximately 12 MW installed capacity. In contrast, a landfill gas to energy company in the UK employs approximately 70 staff to operate over 25 sites around the country with a total installed capacity of 65 MW (these figures include back office staff and central/area management). The significant difference in the ratio of numbers employed per MW installed can be explained to a large extent by the facts that the industry in the UK is reasonably developed: the skill sets required are more widely available; the landfills are well regulated; the operations are relatively well ordered; and the technology used is mature.

The organogram below shows a typical project organisation structure taken from the already quoted working example of an actual LFG energy project in Indonesia with 12 MW of installed capacity on an active and extremely busy landfill.

Oversight of landfill and project management		Local Government DKP/UPTD/BLUD		
		Technical M&E consultant appointed by local government		
PROJECT SITE TEAM		**Head of project operations**		
TECHNICAL AREA	**Landfill gas production**	**Power house & electrical**	**Finance & administration**	**External liaison**
STAFF	6 x technical administration 40 x ground staff	3 x technical administration 6 x operator 5 x mechanics	4 x administration	3 x technical administration
RESPONSIBILITIES	Landfill gas production planning & engineering Technical & environmental compliance Contractor supervision Gas source & well management Inventory management Power house M&E support Liason with PLN support	Engine & auxillaries management Gas source & well management Power house M&E Spares inventory management Liason with PLN support	General administration Project revenue & expenditure Project finance reporting Legal compliance & permitting	Technical & financial Reporting to DKP Engineering responsibility for joint operation

***Figure 11.1**: Example organisation chart from an Indonesian LFG project*

The organisation chart shown in figure 11.1 indicates that staff numbers are concentrated in the GCCS and power house operations.

As can be seen above, the operation of the LFG project is broadly divided into three main areas: operation of the gas field and the gas capture and conveyance system (GCCS); operation and maintenance of the power house and transmission systems; and project finance, administration and liaison. The team in this example is quite large (more than 60 staff), however this is for a project on one of Indonesia's largest landfills. Small- to medium-sized projects are able to cover all operational requirements with around 10 staff.

Most gas engine suppliers can provide comprehensive remote monitoring and control packages, which allow access wherever there is an internet or land line connection. A degree of monitoring and supervision can then be carried out from a remote office and the need or otherwise for manual intervention identified. Although it is possible to operate a system successfully with no permanent site presence, remote operation is more appropriate where the gas supply is known to be relatively stable, such as a closed landfill or cell, which does not suffer from high leachate levels or other influences which may need more constant intervention. It does, however, provide a useful level of monitoring for external troubleshooting assistance, which may be required from time to time.

Roles and Responsibilities

The table below provides a breakdown of the typical roles and responsibilities of a LFG to energy project, including the additional activities necessary when collecting gas from operational areas.

Gas field	Power house	Additional duties, if collecting gas from active areas
Supervisors (power house and gas field supervision could be provided by a single individual where project size and available skill sets allow)		
Ensure maximum gas collection efficiency and that the gas field is operated to industry standards. Ensure correct quantity and specification of pipe, fittings and other materials are available for gas field extensions and running repairs. Ensure all monitoring and installation equipment is in good operating condition, calibrated and that the team is adequately trained in its use. Identify staff training needs. Ensure monitoring, adjustments and maintenance are carried out on time, effectively and recorded. Regularly assess operational monitoring data with the PM to identify areas for improvement Maintain records, including monitoring and adjustments, system drawings, changes/ modifications to the system and specific events. Troubleshoot gas collection/supply issues. Maintain safe working practices, including a permit to work system for the gas field. Liaise with power house supervisor to co-ordinate all changes to fuel supply and minimise risk of reduced power output.	Ensure smooth and safe operation of the power house and maximise availability. Plan maintenance works. Maintain stock levels of spares and consumables. Maintain adequate supply of tools and equipment to conduct all expected works safely. Maintain oil analysis programme, assess results and report findings to PM. Troubleshoot problems with all systems. Supervise maintenance and unscheduled shutdown works. Inspect completed works. Maintain a permit to work system. Identify staff training needs. Routinely inspect borescope. Produce work and call-out rosters. Liaise with gas field supervisor to be aware of changes in the operational aspects of the gas field.	Liaise with landfill design/operations team to co-ordinate tipping plan; schedule and plan pipework movement, gas well installation and expected waste levels; plan condensate drainage and pipe layout; manage anticipated plant movements and access routes.
Operatives/technicians (as above, technicians can also cover both areas of activity)		
Monitor and adjust gas wells to maintain balance. Report data to gas field supervisor. Periodically check surface emissions around gas wells and other cap penetrations. Regularly check and inspect gas wells and collection infrastructure for damage, changes to levels, leachate levels within gas wells, air ingress points and tightness of connections. Deliver correct pipework and fittings to locations around the site as required for modification and extension works. Carry out pipe welding and jointing. Check the operation and maintenance of condensate pumps and leachate pumps within gas wells. Install horizontal collectors. Rectify collection system problems. Assist the power house, as required.	Monitor generator parameters daily and identify deviations for follow up action. Check and maintain gas boosters – drive belts, bearings etc. Carry out scheduled maintenance on all plant[1]. Regularly check safety shutdown devices and maintain control systems on generators and flares. Take care of general tidiness and housekeeping in the power house and gas booster/flare compound to maintain a clean and safe environment. Attend of hours shutdowns to maximise generator availability.	Deploy and connect interim collection systems. Regularly check the system in operational areas. Rectify damage/changes due to landfill operations.

This table provides a detailed list of typical roles and responsibilities in an LFG WtE project

Table 11.1: *Typical roles and responsibilities in a LFG to energy project*

11.3 MONITORING

Once the LGF project has been set up and commissioned, it will run on a constant basis with the exception of downtime for maintenance. The well field and the GCCS must be constantly monitored, managed and maintained in order to respond to changing atmospheric conditions (pressure, temperature and precipitation), as well as shifting physical conditions across the landfill. Site staff should have a well field map to help them plan and monitor changes in gas production and across the landfill. Subtle differences in the age and composition of waste, compaction,

Constant monitoring and evaluation of the gas field is required to maximise yield and identify areas for improvement.

[1] *Includes oil and filter changes, air filter changes, clearing cooling radiators, checking and gapping spark plugs, measuring and recording valve recession and setting valve clearances, visual and audible checks around generator. Maintenance load increases with operating hours, necessitating replacement of turbochargers, cylinder heads, coolant pumps and fans and other components and checking and cleaning of intercoolers etc. If the gas contains siloxanes, this may also include regular removal and cleaning of cylinder heads. It is usual for the power house staff to maintain the gas blower and flare and any gas pre-conditioning equipment. Sensors and control equipment require troubleshooting and frequent replacement.*

The parameters which should be monitored are listed here together with target levels. This is a guide, however, and levels must be set for landfills on a site bt site basis.

Parameter	Target
Vacuum pressure	Normal vacuum measures 10–50 millibars at the wellhead.
Volumetric flow rate	Varies depending on project size.
Temperature	Wellhead gas temperature target depends on ambient temperatures and type of methanogenic bacteria: 30-35° C for Mesophilic and 52 – 60° C for Thermophillic.
Methane (CH_4) concentration	Target level 40 - 50 %.
Oxygen (O_2) concentration	Presence indicates system leakage; 1 to 2 % is a reasonable level, less is better.
Carbon dioxide concentration	25 to 40 %.
Methane/carbon dioxide ratio	>1:1.1 less indicates aerobic activity; this ratio will be less in gas from fresh waste.
Balance gas concentration	Typically nitrogen (N_2), target 15 % on capped site or 20 % on open site.
Carbon monoxide (CO) and hydrogen sulphide	These gases provide information about potential sub-surface fires and corrosive potential. Target is less than 25 parts per million (ppm) by volume. CO levels at 100 ppm or above should be investigated since they may signal a fire. CO levels in gas in fresh waste may be higher and should drop over time.

Table 11.2: *Typical wellhead monitoring parameters*

waste depth and moisture levels result in different wells producing different amounts of gas. Individual wells are adjusted and balanced to allow the efficient steady-state operation of the system without excessive vacuum application. The well field operators must maintain a constant, balanced vacuum across the system and should monitor flow rates (a vacuum can be present without flow, if the well is blocked, therefore necessitating flow measurements). Excessive vacuum must be avoided to prevent air intrusion and sub-surface fires.

The system may require further balancing between the well field vacuum and pressure at the blower discharge to achieve proper delivery pressure to the flare or energy use device. The LFG blower should be continuously monitored for unusual noise, temperature or excessive vibration.

Monitoring is a constant process to maintain optimal operation and to plan for system adjustment and maintenance. Monitoring involves examining LFG conditions at the wellheads, pipeline and the waste mass surface. The operating team should monitor gas content for signs of air intrusion and sub-surface fires, and gas quality to the generator. The wellhead parameters typically monitored are shown in table 11.2.

It should be noted that the above table aims to provide a typical guide range for monitoring and not all landfills will be the same. The presence of nitrogen and oxygen in the LFG mixture is the result of air intrusion through the surface of the waste mass or leaks in the system piping. If the latter, the ratio of nitrogen to oxygen will be approximately 4:1, which is characteristic of atmospheric air. When air intrusion through the waste mass occurs as a result of high vacuum levels, the ratio of nitrogen to oxygen in the resulting LFG mixture at the well can be much higher.

11.4 GENERAL MAINTENANCE

As the plant will be running constantly, carefully planned and executed maintenance is essential for the success of the project. Maintenance activities can be classified under three broad headings:

In such an active and dynamic environment as represented by landfills and their associated WtE facilities, routine and planned maintenance are absolutely essential; they must be budgeted for and carefully scheduled.

Routine – this occurs in the normal course of operation or during regular monitoring, often triggered as a result of the monitoring activities identifying maintenance needs. Most of these activities can be conducted without the need to shut down parts or the whole WtE operation.

Planned – pre-scheduled periodic (daily, monthly, annual) maintenance is required to prevent system failure, ensure reliability and optimise operation. Activities are often based on measures taken from equipment manual maintenance schedules or guidelines. Documentation of scheduled maintenance is useful in reviewing the maintenance history of equipment and may be helpful in troubleshooting potential problems and planning the purchase and stocking of spare parts. Major maintenance will often require system shut-down, therefore planning is critical to limit its impact, such as scheduling the work for off-peak power periods, or in line with other maintenance activities or site changes that necessitate system shut-down.

Emergency maintenance cannot be planned, but it can be planned for. Emergencies should be used to determine future preventative measures.

Unplanned/Emergency – this maintenance is required as a result of component failure, system blockages or similar unforeseen emergencies. Management and maintenance teams must consider potential failures, develop response strategies and stockpile spare parts and equipment to mitigate lengthy shutdowns. The team should post signage at key locations across the site to make people aware of hazards that could cause system failures, such as driving heavy equipment across unprotected areas of the GCCS. When emergency failures occur, the project team should investigate the cause to determine what future preventative measures can be put in place.

Chapter Checklist	✔
Now that you have read this chapter:	
Do you know how you can work with the private sector to produce energy from waste?	
Have you got the right numbers of operators for your WtE plant, do they have the required know how and experience and do they understand their roles and responsibilities?	
Are you applying the correct monitoring and maintenance regimes to ensure safe and efficient operation?	

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

CHAPTER 12

MANAGING THE RISKS

WHAT THIS CHAPTER IS ABOUT

We look at the management, mitigation and allocation of the technical and financial risks associated with waste to energy (WtE) projects under public private partnership (PPP) schemes.

We examine the importance of including agreed, clear, practical, and commercially viable risk allocation provisions in project documentation.

We consider risk mitigation strategies based on separating speculative risks from non-speculative risks.

THE KEY POINTS

- How risks can be shared between the government and the private sector. *page 180*
- How to identify financial, commercial and technical risk at all stages of the WtE project cycle in Indonesia. *page 181*

12.1 RISK ALLOCATION

Efficient and equitable allocation of risk results in more successful and profitable projects.

In practice, risk tends to be allocated on the basis of commercial and negotiating strength. Improperly allocated risk will have an impact on the entire project and may affect the stronger party as well as the weaker one. Efficient allocation of risk will generally result in a more successful and profitable project, benefiting all the parties involved.

The figure below describes how project risk is efficiently allocated

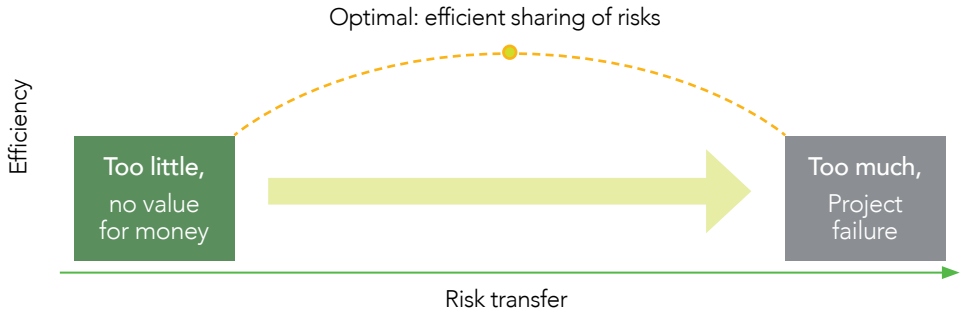


Figure 12.1 *The efficient allocation of risk*

Lenders will want risk to be carried by the participants in the project, who are better placed to manage it.

Infrastructure projects, such as WtE developments, are best funded through schemes designed to raise project finance. The huge amounts of capital required by infrastructure projects mean that corporate financing is not suitable for this type of venture. Many developers want to distance their existing balance sheet from the possibility of project default in the future. Under a project finance scheme, the future cash flow from a project's assets is used to service the underlying debt. In some cases, however, some limited funding is required from the project's shareholders to enhance the quality of credit.

The following diagram describes the risk perspective of stakeholders providing project finance in infrastructure projects:

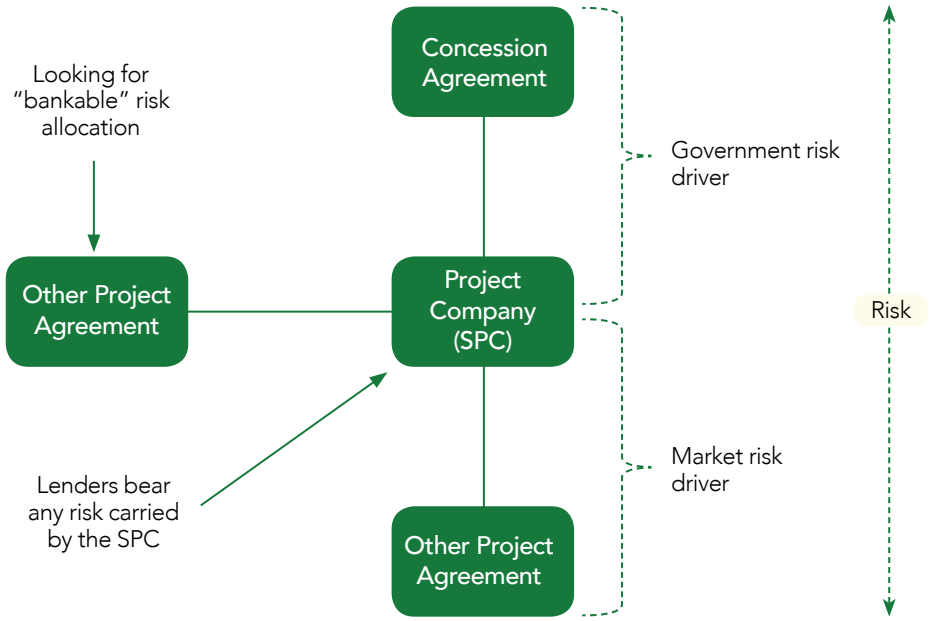


Figure 12.2 *Risk allocation in project finance*

Lenders will want risk to be carried by the participants in the project who are better placed to manage it.

In order to avoid bearing project risk, the lenders, when reviewing the project documentation, will insist that, as far as possible, risk is allocated to the project participants, such as the construction contractor and the operator, and away from the project company, i.e. their debtor.

The project participants will charge higher fees (a risk premium) for bearing such project risks and include them in the contract price, increasing the financial exposure of the lenders. However, such increases represent value for money for the lenders, since the project participants are better placed to manage such risks and the lenders will be able to evaluate their exposure and cost the risk.

To minimise the impact of uncertainties, project participants must recognise the risks, understand their accountability, know how to manage risk effectively and be willing to share risk equitably through the contractual process.

12.2 THE RISK MATRIX FOR WTE PROJECTS UNDER PPP ARRANGEMENTS

One of the keys to a successful project lies in the sponsor's ability to identify and equitably distribute risks during project development. It is essential that all areas of concern be identified and discussed, no matter how unlikely their occurrence may be. It is also necessary to establish an efficient system for managing these risks should they become imminent; this forms the basis of the contractual agreements formalising risk allocation and management.

The first step in risk mitigation is to segregate speculative risks from the non-speculative. Generally, non-speculative risks are those which threaten loss and offer no potential for gain (e.g. fire, earthquake, flood, and force majeure). Such risks are generally insurable. Speculative risks offer the risk taker economic gain in return for effective performance and proper risk management. At the end of the day good management and prudence are the risk taker's insurance against loss.

Naturally, each participant wants to protect his own interests. The governmental unit does not want to burden its tax payers and wants the project to be self-sufficient; the engineer/constructor wants to receive reasonable compensation for their services; the bond holders want to be assured of timely payment of principal and interest. However, risk mitigation is a give and take situation. If any risks are assigned without regard to a participant's ability to control them, the project has little hope of success.

The risk matrix shown in table 12.1 below is based on a build-operate-transfer (BOT) arrangement, under which the private company (PC) is responsible for production, operation and maintenance, but does not undertake either the waste collection or the retail tariff collection tasks.

In this table we summarise how risk is shared between public and private entities and what mitigation strategies are available to address site risks…

Risk Event	Public	Private	Shared	Mitigation Strategy
Site risks				
Delay in land acquisition and overrun of costs. Delays and cost increases due to unclear, and then prolonged, land acquisition process.	●			The government clears project land/ site before the procurement process.
Land acquisition cannot be fully completed. Unable to acquire project land/site due to difficulties in the land acquisition process.	●			Clearly establish the legal status of the land and set out clear procedures for project-related land clearance.
Complex resettlement process. Delay and cost overrun due to a complicated resettlement process.	●			Fair compensation for, and good communication with, those impacted.
Land tenure risk. Multiple land ownership certificates are discovered after the project has started or been implemented.	●			Validate land tenure, with support from the relevant authorities (National Land Agency (BPN), Agency of Demography, etc.).
Unforeseen difficulties concerning site conditions. Delay due to uncertainties concerning ground conditions.		●		Apply historical data concerning land use and carry out site investigations.
Damage of artefacts and antiquities at the site.		●		Apply historical data concerning land use and carry out site investigations.
Failures in site safety.		●		Implement good work safety procedures.
Contamination/pollution of the site environment.		●		Comply with good environmental impact analysis.
Distress to the surrounding community. Due to potential discomfort from the process/ outputs.		●		Socialisation about the benefit of project to community
Failure to apply EIA (Environment Impact Assessment/AMDAL).		●		Employ a competent specialist consultant to investigate the environmental consequences.
Design, construction and commissioning risks				
Unclear output specifications. Time and cost overruns due to unclear output specification.	●	●		Clarify the specifications during the tender process; ensure good design capacity.
Design faults. Technical commissioning leads to discovery of design faults.		●		Employ a good and experienced design consultant.
Delay in completing construction works. May include delays in returning site access.		●		Employ competent contractors and standard contract clauses.
Construction costs increase.		●		Include price escalation factor clauses in the contract.
Commissioning risk. Incorrect time/cost estimates of technical commissioning.		●		Ensure good coordination between contractor and operator.
Sponsor risks				
Poor performance of subcontractors.		●		Apply a credible selection process for sub-contractors.
Default by sub-contractors.		●		Apply a credible selection process for sub-contractors.
Default by the PC. PC's default leads to termination and/or intervention by financiers		●		Ensure the consortium is supported by credible and solid sponsors.
Default of project sponsor. A sponsor (or a member of the consortium) defaults.		●		Apply Pre -Qualification (PQ) process to select credible sponsors.

…design, construction and commissioning risks…

…sponsor and financial risks…

Risk Event	Public	Private	Shared	Mitigation Strategy
Financial risks				
Failure to achieve financial close. Inability to achieve financial closure due to market uncertainty.		●		Ensure good coordination between potential lenders.
Financial structure risk. Inefficiency due to inadequacies in the project's capital structure.		●		Ensure the consortium is supported by credible sponsors/ lenders.
Foreign exchange rate risk. (Non-extreme) fluctuations in the foreign exchange rate.		●		Use hedging instruments; finance in Rupiah.
Inflation rate risk. The inflation rate used for estimating life-cycle costs increases.		●		Apply a tariff indexation factor; re-base the tariff.
Interest rate risk. (Non-extreme) fluctuation in the loan interest rate.		●		Apply interest rate hedging.
Insurance risk (1). Insurance cover for a certain risk is no longer available from reputable insurers in the market.		●		Consult with insurance specialists/ brokers.
Insurance risk (2). Substantial increases in the rate used to calculate insurance premiums.		●		Consult with insurance specialists/ brokers.
Operating risks				
Non-availability of facilities. Due to lack of facilities, the project cannot be completed.		●		Employ a competent contractor.
Poor performance of services. Due to lack of facilities, the project cannot operate.		●		Employ a competent operator; apply clear output specifications.
Industrial action. Industrial action (strike, lockout, go slow, etc.).		●		Apply good human resources and industrial relations policies.
Social and cultural risk. Risks arising from not considering the cultural or social circumstances of local communities during the project's implementation.		●		Implement a people-oriented community engagement programme; ensure community empowerment.
Risk arising from failures in project management. Failure or inability to manage the operational aspects of the project.		●		Develop operational and management plans and apply them professionally.
Failure in control and monitoring. Irregularities were not detected due to the failure in control and monitoring by the PC or the Contracting Agency (CA).	●	●		Develop control and monitoring plans and periodically evaluate the effectiveness of the design and implementation of the control and monitoring procedures.
Risk of overrun of operation and maintenance (O&M) costs. Incorrect estimation of O&M costs or an unexpected increase in these costs.		●		Employ a competent operator; apply a contract escalation factor.
Estimation of life cycle expenditure is incorrect.		●		Deal/contract with suppliers as early as possible.
Increase in energy costs due to inefficient plant.		●		Specify good quality units.
Irregular availability of required utilities.		●		Take measures anticipating irregularities; provide electricity back-up facilities/other utilities.
Disruption of transportation routes and schedules.	●			Ensure good management of the waste transportation system.
Water pollution during transportation.	●			Establish effective service level criteria and transportation system procedures.
Shortfall in input (waste) quantities.	●			Set waste supply guarantees; embed waste management procedures in the community.

…operating risks …

…operating risks …

…revenue risks…

…network connectivity and interface risks…

…political risks…

Risk Event	Public	Private	Shared	Mitigation Strategy
Operating risks				
Decrease in input quality (i.e. waste composition).	●			Limit the influence of the waste collector over waste composition.
Non-compliant output quality.		●		Specify the correct technology to be used.
Revenue risks				
Change in the volume of the demand for the project output. Resulting in a decrease in revenue and losses for the PC.	●			Ensure that policies are synchronised and consistent with project goals.
End (retail) consumers do not pay. The ability and willingness of end users to pay for the outputs are below feasible levels.	●			Ensure a good socialisation programme is in place; provide feasibility support through viability gap funding (VGF); enact supportive regulation.
Periodical tariff adjustment is delayed.	●			Ensure good operational performance; enact supportive regulation.
The level of the adjusted tariff is lower than initially projected.	●			Ensure good operational performance; enact supportive regulation.
Tariff estimates are miscalculated.		●		Conduct an accurate users' affordability and willingness survey.
Network connectivity risks				
Network risk (1). Uncertainty in existing waste collection network.	●			Apply good supervision and operational performance standards.
Network risk (2). Breach of authority's obligation to maintain required waste collection network.	●			Ensure a good understanding of the contract by the public sector.
Network risk (3). Breach of authority's obligation to maintain required facilities.	●			Ensure a good understanding of the contract by the public sector.
Interface risks				
Interface risk (1). Imbalance between input and treatment capacity in the early years of operation.	●			Use "take or pay" clause in the waste supply contract.
Interface risk (2). Disparity in the quality of the result of works undertaken by government and by the PC.	●	●		Remedial action to be carried out by the party, which has undertaken the lower quality work.
Political risks				
Currency inconvertibility. Unavailability and/or inconvertibility of the local currency into the investor's domestic currency.	●			Apply: ▪ local financing; ▪ off-shore account; ▪ political risk insurance; ▪ central bank guarantee.
Non-transfer of currency. Inability to transfer funds into foreign currency and the investor's home country.	●			Apply: ▪ local financing; ▪ off-shore account; ▪ political risk insurance; ▪ central bank guarantee.
Expropriation risk. Nationalisation/ expropriation without (adequate) compensation.	●			Apply: ▪ mediation; ▪ negotiation; ▪ political risk insurance; ▪ government guarantee.
General change in law (including tax). Can be considered as business risk.		●		Apply: ▪ mediation; ▪ negotiation; ▪ political risk insurance; ▪ government guarantee.
Discriminatory or project-specific change in law (including tax). In form of tax policies introduced by the relevant authority (central or regulatory).	●			Apply: ▪ mediation; ▪ negotiation; ▪ political risk insurance; ▪ government guarantee.
Delay in achieving planning approval. Only if caused by the authority's unilateral/ incorrect decision.	●			Include clear contract provisions, including compensation.

Risk Event	Public	Private	Shared	Mitigation Strategy
Political risks				
Failure or delay in obtaining necessary consents (excl. planning). Only if caused by the authority's unilateral/ incorrect decision.	●			Include clear contract provisions, including compensation.
Delay in gaining access to the site. Only if caused by the authority's unilateral/ incorrect decision.	●			Include clear contract provisions, including compensation.
Parastatal risk (1). Default in the contractual obligations of the PC as off taker.	●			Apply: ▪ political risk insurance; ▪ government guarantee.
Parastatal risk (2). As a result of the privatisation of off taker or the default of the PC.	●			Apply: ▪ political risk insurance; ▪ government guarantee.
Termination due to the default of the PC.	●			Apply a government guarantee.
Force majeure risks				
Natural disasters. Catastrophic events/ acts of God.			●	Obtain insurance, to the extent possible.
Political force majeure. Events of war, riots, civil disturbance.			●	Obtain insurance, to the extent possible.
Extreme weather.			●	Obtain insurance, to the extent possible.
Prolonged force majeure. If force majeure persists longer than 6 to 12 months, the affected party may face economic problems (especially if insurance is no longer available).			●	Either party should be able to terminate the PPP contract and trigger an early termination project buyout.
Asset ownership risks				
Risk of an event leading to asset loss. Fire, explosion, etc.		●		Obtain insurance.

…and, finally, force majeure and asset ownership risks.

***Table 12.1**: Risk matrix for a BOT WtE project*

Chapter Checklist ✔

Now that you have read this chapter:

Have you taken account of the risks associated with all stages of the WtE project cycle in Indonesia?

- site
- design, construction, commissioning
- sponsorship
- finance
- operating
- revenue
- network connectivity
- interface
- political
- force majeure
- asset ownership

Do you have effective mitigation and management strategies in place for each of these risks?

How are you allocating the risks between the parties and are there options for risk sharing between the government and the private sector?

If you still have questions or comments please join the forum at www.wteindonesia.com
To access a complete set of supporting documents, including templates, to assist you in your WtE project, go to: www.ebtke.esdm.go.id

ANNEX TO CHAPTER 9

DESCRIPTION OF THE PROCESS FOR SELECTING PRIVATE ENTITIES IN PPP PROJECTS

Single-stage Open Bidding

Distribution of the Request for Proposal (RfP)

All the bidders who have pre-qualified will be requested by e-mail to submit proposals. The RfP document comprises, as a minimum:

- An information memorandum covering the PPP project.
- Instructions to bidders, including: general instructions (consortium provisions, due diligence, the bid schedule, information on the data room and signing of the contract); preparation of the proposal (prevailing language, structure and content of the proposal, validity, form of proposal and expression of interest); submission of the proposal (deadline, dealing with late proposals); confidentiality; conflict of interest; method of communication with the bidding committee; competition requirements; bidders' responsibilities; and commitment to corporate arrangements.
- Provisions for opening and evaluation of bids (the committee should clearly describe the bid opening procedures and the criteria for of evaluating the bid).
- Prohibition of corrupt practices.
- Services specification requirements, including but not limited to: standards of working or services; the standard, condition and value of the assets at the end of the project; and minimum specifications.
- Risk allocation matrix.
- The payment mechanism for the services provided under the PPP project, PPP project financing and provisions for incentives and penalties.
- The financing model and sources of funds.
- Legal, social and environmental requirements.
- Guarantees and their requirements.
- Any other issues considered necessary.

Attachments to the RfP may include the information memorandum, the draft concession agreement and the primary provisions required for the setting up of a guarantee (if a government guarantee is required).

Issuing of the Non-disclosure Letter

The bidders must submit a non-disclosure letter immediately after they have received the RfP and obtained access to the data room.

Pre-bid clarifications

Clarifications should be given in an open, transparent and non-discriminatory manner within the period of time and in the place stipulated. Bidders should also be invited to contribute to the clarification process, which may be conducted through pre-bid conferences and site visits, and in writing.

If clarifications are given through a pre-bid conference, bidders may raise queries directly. However, the absence of a bidder from a bid conference does not disqualify that bidder from taking part in the bidding process. The conference proceedings should be minuted and the minutes signed by the Bidding Committee. If no bidder is present the minutes are signed by the Bidding Committee only.

If the clarification exercise is carried out in writing, the bidders may submit their queries as soon as they receive the RfP and up to the deadline for submission. The committee should respond

immediately and issue the queries and the responses to all bidders. All correspondence should be attached to the minutes of the clarification exercise.

If the clarification exercise involves a site visit, the clarifications given should be recorded and included in the minutes of the site visit.

In a clarification exercise, the Bidding Committee should provide clarifications of the following as a minimum:

- the steps in the selection process;
- the contents of the RfP;
- the requirements at each stage of selection;
- the draft concession agreement; and
- all documents relevant to the PPP project.

Amendments to the RFP (if necessary)

If the clarification exercise results in modifications to the RfP, the Bidding Committee should modify the document accordingly subject to the approval of the GCA. If the modifications are approved, then the amended RfP should be distributed to all bidders by the Bidding Committee. If necessary, the Bidding Committee may grant additional time to prepare the proposal.

Proposal submission – envelope I and envelope II

The proposal is submitted in two envelopes. The first envelope contains administrative and technical documents. The second envelope contains the financial document.

The administrative documents should include at least:

- the offer letter;
- the Power of Attorney;
- the consortium agreement;
- any statement necessary; and
- the bid bond.

As a minimum the technical documents contain at least:

- the technical data (technical information, drawings, performance data, environmental data, a project summary and asset transfer plans);
- supporting data;
- the project implementation schedule; and
- the plans for the organisation and management of the PPP project.

Opening of the proposal – envelope I

The fundamental aspect of the proposal opening process is the presence of witnesses. The committee may ask representatives of the bidders to attend in order to witness the opening. If no bidder is present, the opening is postponed for one hour. If no one arrives, the opening should then be witnessed by two external persons appointed by the Bidding Committee. The opening should be minuted and the minutes distributed to the bidders.

Evaluation - envelope I

The Bidding Committee evaluates the contents of envelope I based on the procedures set out in the bidding document. Evaluation takes two forms:

- Administrative evaluation

  This evaluation is based on a simple 'pass/fail' system. Proposals not substantially compliant with administrative requirements are disqualified. It should be noted that there must be substantial reasons for disqualification.

- Technical evaluation

  Only bids passing the administrative evaluation are subject to technical evaluation. This evaluation compares the technical responses of the bidders to the requirements set out in the RfP. The pass grade out of a total score of 100 is stipulated in the bidding document. The Bidding Committee may ask the bidders to present their technical proposals. Should no proposals pass the technical evaluation, the tender process is deemed to have failed.

Announcement of the results of the evaluation of envelope I

The tender committee shares the result of the evaluation of this stage with all the bidders. Those who do not pass are given the reasons for their failure to qualify. This information may be conveyed electronically.

Opening of the proposal – envelope II

Just like the opening of envelope I, the fundamental feature in opening envelope II is the presence of witnesses. The fundamental provisions for opening envelope II are therefore the same as for envelope I.

Evaluation of the contents of envelope II

The Bidding Committee evaluates the contents of envelope II based on the procedures set out in the bidding document. The committee may adopt the best financial offer system to determine the successful bidder, which means that the bidder proposing the lowest price/tariff/Government Support (availability payment/viability gap fund) will be declared the winner. However, a scoring system may also be used, under which the bidders are ranked on the basis of their combined technical and financial scores.

In conducting the evaluation, the Bidding Committee may introduce arithmetical corrections, and may ask the bidders to present their financial proposals. Should no proposals pass the financial evaluation, the tender process is deemed to have failed.

Issuing of the Minutes of the Tender Process

Following the evaluation of the contents of envelope II, the Bidding Committee issues the minutes of tender process. These minutes should contain a summary of the evaluation results and should include:

- the names of all the bidders;
- the estimated value of the investment offered by the bidders;
- the evaluation methods used;
- the matters that have been evaluated;
- other information concerning tender implementation;
- the number of bidders who have passed and failed;

- the dates the evaluation took place; and
- the bidders' rankings.

Awarding the tender winner

Based on the minutes, the Bidding Committee reports to the GCA naming the winner. If the GCA does not agree about the selection of the private entity proposed, then the Bidding Committee and the GCA discuss the matter to arrive at an agreed decision, which should minuted and signed by the Bidding Committee and the GCA. The decision may be to uphold the original decision or to re-run the evaluation.

Announcement of the tender winner

Based on the GCA's decision, the Bidding Committee announces the result to all bidders by e-mail and through media such as newspapers and the GCA's own website. The announcement is made after minutes of the tender process have been issued.

Objections

Bidders have the right to object to the tender result, for the following reasons:

- violation of the procedures set out in the bidding document and/or the prevailing regulation;
- the discovery of any arrangement which could give rise to unfair competition; or
- misuse of authority.

Issuing of the award letter

The GCA should issue the award latter no later than seven working days after objections have been addressed, if the following conditions are in place:

- there are no objections from the bidders;
- the objections are overturned;
- the period for raising objections set out in the bidding documents has expired; and
- the winning bidder has extended the bid validity up to the signing of the concession agreement.

If the winning bidder withdraws after this letter has been issued, the GCA reserves the right to cash in the bid bond and issue the letter to the next bidder. However, if all the bidders withdraw, then the tender is deemed to have failed.

Preparation of the PPP contract for signature

The GCA prepares the cooperation agreement for signature on the basis of the award letter, including the following provisions:

- the letter of appointment is issued to the selected private entity within ten days of the issuing of the award letter; and
- the cooperation agreement has been finalised.

The GCA may be assisted by the PPP team and the Bidding Committee in carrying out these activities.

Two-stage Open Bidding

Distribution of the RfP

The provisions for distributing the RfP may be the same as those applied in single-stage open bidding.

Issuing of the Non-disclosure letter

The provisions for issuing the non-disclosure letter may be the same as those applied in single-stage open bidding.

Pre-bid clarifications

The provisions for the pre-bid clarifications may be the same as those applied in single-stage open bidding.

Amendments to the RfP (if necessary)

The provisions for amending the RfP may be the same as those applied in single-stage open bidding.

Submission of the proposal – stage I (administration and technical documents),

In stage I the bidders submit documents containing administrative and technical information.

The administrative documents should include, as a minimum:

- the offer letter;
- the Power of Attorney;
- the consortium agreement;
- any statements necessary; and
- any inputs or amendments to the PPP concession agreement.

The technical documents should contain at least:

- the technical data (technical information, drawings, performance data, environmental data, operational and maintenance data, summary of the project and asset transfer plans);
- supporting data;
- a project implementation schedule; and
- the plans for the organisation and management of the PPP project.

Opening of the bid – stage I

The provisions for bid opening are the same as those applied in single-stage open bidding.

Evaluation of the stage I,

The Bidding Committee evaluates the proposal based on the procedures set out in the bidding document. Evaluation takes two forms:

- Administrative evaluation

  This evaluation is based on a simple 'pass/fail' system. Proposals not substantially compliant with administrative requirements are disqualified. It should be noted that there must be substantial reasons for disqualification.

- Technical evaluation

  In principle, the technical evaluation is carried out to ensure that the proposals from the bidders satisfy the requirements set out in the RfP and meet the service level provisions stipulated in the draft cooperation agreement.

Only bids passing the administrative evaluation are subject to technical evaluation. This evaluation compares the technical responses of the bidders to the requirements set out in the RfP. The pass grade out of a total score of 100 is stipulated in the bidding document. The Bidding Committee may ask the bidders to present their technical proposals. Should no proposals pass the technical evaluation, the tender process is deemed to have failed.

Announcement of the results of the stage I evaluation to all bidders

The tender committee shares the result of the evaluation of this stage with all the bidders. Those who do not pass are given the reasons for their failure to qualify. This information may be conveyed electronically.

Discussions concerning technical improvements, financial matters and the drafting of the PPP contract

Bidders who pass the stage I evaluation are invited to one-on-one meetings to discuss technical improvements, financial matters and the draft cooperation agreement. Prior to the meeting the bidders are asked to submit their list of questions related to these issues. These discussions are limited to the required outputs without any changes to the minimum requirements. The results of the discussions should be minuted. Depending on the outcome of the discussions, the Bidding Committee may review, and make necessary adjustments to the specifications in order to obtain improved offers, if required. If such adjustments are deemed necessary, then amendments to the RfP are made; if this is not necessary, then the Bidding Committee asks the bidders to submit their proposals for the next stage of the process.

Amendments to the RFP (if necessary)

If modifications are required to the RfP as a result of the above discussions, the Bidding Committee should make the necessary changes, subject to the GCA's approval, which should be given within five working days. If the modifications are approved, the Bidding Committee must distribute an amended RfP to all bidders. In this case, if necessary, the Bidding Committee may grant additional time to prepare the proposal.

Submission of the proposal – stage II (technical and financial documents)

During this stage, the bidders are asked to submit their proposals according to the RfP and any amendments to it. The bidders who participated in the discussions may withdraw should they wish not to submit the proposals. The documents submitted at this stage comprise: **administrative documents, technical documents, financial documents and the draft of the proposed cooperation agreement.**

The administrative documents should include, as a minimum:

- bid security to the value of at least 1% of the total investment value;
- asset transfer plans for the end of the concession period; and
- any other relevant information.

The technical documents should contain at least:

- the technical data (technical information, drawings, performance data, environmental data, a project summary and asset transfer plans);
- supporting data;
- the project implementation schedule; and
- the plans for the organisation and management of the PPP project.

The financial documents should contain, as a minimum:

- the financial offering, including government guarantee requirements;
- financial plans;
- financial models, including: initial capitalisation plans; investment plans; operations and maintenance costs; cash flow report; financial balance sheet; profit and loss balance sheet; the IRR; the debt service coverage ratio; and the tariff calculation.

Opening of the proposal – stage II

The provisions for the opening of the bid in stage 2 may be the same as for the single-stage process.

Evaluation of stage II

In this stage, the Bidding Committee evaluates the proposal in accordance with the procedures set out in the bidding document. The procedures cover three types of evaluation:

- Administrative evaluation

  Administrative evaluation at stage II is simply to make sure that all the documents required by the RfP (in its original form or as amended following discussion) have been submitted.

- Technical evaluation

  The technical evaluation at this stage is, in principle, conducted to see whether the offer is technically compliant with the requirements stipulated in the RfP (in its original form or as amended following discussion).

- Financial Evaluation

  This evaluation is undertaken simply to compare the offer with the requirements of the RfP.

- Combined Technical and Financial Evaluation

  After the technical and financial evaluations have been carried out the Bidding Committee combines the evaluation scores according to the proportions stipulated in the RfP. If the PPP project is to receive viability gap funding, the proportion for the financial evaluation is set higher than that for the technical. Finally, the Bidding Committee determines the ranking on the basis of the combined score.

Issuing of the Minutes of the Tender Process,

The provisions for the issuing of the minutes of the tender process may reflect those described under single-stage open bidding.

Award of the tender winner,

The provisions for the award of the tender winner may reflect those described under single-stage open bidding.

Announcement of the tender winner,

The provisions for the announcement of the tender winner may reflect those described under single-stage open bidding.

Objections

The provisions for addressing objections may reflect those described under single-stage open bidding.

Issuing of the award letter

The provisions for issuing the award letter may reflect those described under single-stage open bidding.

Preparation of the PPP contract for signature

The provisions for preparing the PPP contract for signature may reflect those described under single-stage open bidding.

Direct Appointment under Specific Conditions

The stages required for direct appointment of a tender winner under the 'Specific Conditions' are as follows:

Distribution of the RfP to the targeted private entity

The RfP is issued to the private entity in question meeting the 'Specific Conditions' criteria, together with the qualification document and letter of confidentiality.

Submission of the qualification document

The qualification documents include the administrative, technical and financial documents.

Evaluation of the qualification process

Evaluation is carried out to determine whether the private entity in question complies with the requirements set out in the RfP.

Submission of the offer

The offer is submitted in one envelope, containing the administrative, technical and financial documents.

Evaluation, clarification and negotiation

Evaluation, clarification and negotiation are conducted accordance with the provisions set out in the RfP. It is the responsibility of the Bidding Committee to ensure that clarifications are provided and technical and financial negotiations carried out. This stage also involves the preparation of the draft concession agreement. The outcomes of the evaluation, clarification and negotiation activities should be minuted.

The announcement of the result of the direct appointment process and the issuing of minutes of the direct appointment evaluation in order to obtain GCA approval

The announcement of the result of the direct appointment is intended to obtain agreement from the GCA. The announcement should have a summary of the evaluation, clarification and negotiation process attached.

Decree and announcement of the contract award

Having gone through all the processes outlined above, the GCA issues a decree appointing the private entity selected. The Bidding Committee makes the decree announcement.

Signing of the PPP contract

The GCA prepares the cooperation agreement for signature by the GCA itself and the private entity. The document should be prepared taking into account all the minutes and records made during the qualification and selection process, including the draft concession agreement.

Direct Appointment in the case of one pre-qualified bidder

The stages required for direct appointment of a tender winner in the case of one pre-qualified bidder are as follows:

Submission of an invitation to bid to the single pre-qualified company

The provisions for this phase are the same as those for the distribution of the RfP in the case of direct appointment under 'Specific Conditions'.

Clarifications concerning the PPP project

Should new information concerning the PPP project itself come to light, it is possible that the single qualified private entity may to require a clarification. Any changes resulting from the clarification exercise must be included in the RfP.

Submission of the offer

The offer is submitted in one envelope containing the administrative, technical and financial documents.

Evaluation, clarification and negotiation

The provisions for this stage are the same as those for evaluation, clarification and negotiation in the case of direct appointment under 'Specific Conditions'.

The announcement of the result of the direct appointment process and the issuing of minutes of the direct appointment evaluation in order to obtain GCA approval

The provisions for this phase are the same as for those covering the announcement of the result in the case of direct appointment under 'Specific Conditions'.

Decision and announcement of the contract award, and signing of the PPP contract

The provisions for this stage are the same as those for similar activities in the case of direct appointment under 'Specific Conditions'.

LIST OF TABLES AND FIGURES

LIST OF ABBREVIATIONS USED

English abbreviations	
3Rs	recycling, reduction and re-use
AD	anaerobic digestion
APC	air pollution control
B to B	business to business
BATMAN	best available technology meeting actual needs
BATNEEC	best available technology not entailing excessive cost
BOOT	build-own-operate-transfer
BOT	build-operate-transfer
BTO	build-transfer-operate
CA	cooperation agreement
CAPEX	capital expenditure
CAPM	capital asset pricing model
CDM	clean development mechanism
cfd	cubic feet per day
CHP	combined heat and power
CNG	compressed natural gas
CWB	community-based waste banks
DED	detailed engineering design
DOT	develop-operate-transfer
DSCR	debt service coverage ratio
EBIDTA	earnings before interest, tax and depreciation expenses
EBIT	earnings before interest and tax expenses
ECM	environmental control measure
EHS	environmental health and safety
EIA	environmental impact assessment
EOI	expression of interest
EPA	environmental protection agency
EPC	engineering, procurement, construction
FGC	fuel gas compressor
FS	factor of safety
FS	feasibility study
GA	guarantee agreement
GCA	Government Contracting Agency
GCCS	gas capture and conveyance system
GCL	geosynthetic clay liner

GG	government guarantee
GHG	greenhouse gas
GoI	Government of Indonesia
GPS	global positioning system
GR	Government Regulation
HDPE	high-density polyethylene
HE	heavy equipment
IEE	initial environmental examination
IG	Infrastructure Guarantee
IIGF	Indonesia Infrastructure Guarantee Fund
IndII	Indonesia Infrastructure Initiative
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
IRR	internal rate of return
ISWA	International Solid Waste Association
ISWM	integrated sustainable waste management system
ITF	integrated waste treatment facilities
LEL	lower explosive limit
LFG	landfill gas
LG	local government
LMOP	Landfill Methane Outreach Programme
LOTO	lock out and tag out
LTP	leachate treatment plant
MEMR	Ministry of Energy and Mineral Resources
MoF	Ministry of Finance
MoPW	Ministry of Public Works
MRF	material recovery facility
MSW	municipal solid waste
NCV	net calorific value
NPV	net present value
O&M	Operation and Maintenance
OGM	operating guide manual
OPEX	operating expenditure
PC	private company
PFI	Private Finance Initiative
PIC	prior informed consent

PM	project manager
PPA	power purchase agreement
PPE	personal protective equipment
ppm	parts per million
PPP	public private partnership
PQ	pre-qualification
PR	Presidential Regulation
pre-FS	pre-feasibility study
PSI	private sector investment
RDF	Refuse-derived fuel
RFP	request for proposal
ROEs	regency-owned enterprises
ROI	return on investment
ROT	rehabilitate-operate-transfer
SOEs	state-owned enterprises
SOPS	standard operator training
SPC	special purpose company
SWM	solid waste management
syngas	synthesis gas
TCF	EU-Indonesia Trade Cooperation Facility
tpd	tonnes per day
UEL	upper explosive limit
UNFCCC	United Nations Framework Convention on Climate Change
VGF	viability gap funding
VOC	volatile organic compound
WACC	weighted-average cost of capital
WM	waste management
WtE	waste to energy
Bahasa abbreviations	
AMDAL	Analisis Mengenai Dampak Lingkungan (environmental impact assessment)
APBD	Anggaran Pendapatan Belanja Daerah (Regional Budget)
APBN	Anggaran Pendapatan Belanja Negara (State Budget)
BAPPENAS	Badan Perencanaan Pembangunan Nasional (Agency for National Development Planning)
BKPM	Badan Koordinasi Penanaman Modal Indonesia (Indonesia Investment Coordinating Board, Directorate of Infrastructure Planning)
BLUD	Badan Layanan Umum Daerah (Local Public Service Agency, used to manage large regional landfill facilities)
BPN	Badan Pertanahan Nasional (National Land Agency)

BRR	Badan Rehabilitasi dan Rekonstruksi (GoI's Rehabilitation Agency)
BUCP	Badan Usaha Calon Pemrakarsa (Candidate for Project Initiator)
BUP	Badan Usaha Pemrakarsa (project initiator)
DBH	dana bagi hasil (Shared Fund)
DIPA	Daftar Isian Pelaksanaan Anggaran (budget plan)
DKP	Dinas Kebersihan dan Pertamanan (Local Sanitary Agencies)
DNI	Daftar Negatif Investasi (negative investment list)
EBTKE	Direktorat Jenderal Energi Baru, Terbarukan, dan Konservasi Energi (Directorate General of New, Renewable Energy and Energy Conservation)
KSP	Kerjasama Pemanfaatan (Cooperative utilisation)
KSPI	Kerjasama Penyediaan Infrastruktur (Cooperation for Providing Infrastructure)
LAKIP	laporan pertanggungjawaban tahunan (annual accountability report)
LKPP	Lembaga Kebijakan Pengadaan Barang/Jasa Pemerintah (National Procurement Agency)
PD	Perusahaan Daerah
PII	PT Penjamin Infrastruktur (Infrastructure Guarantor Company)
PLN	Perusahaan Listrik Negara (state-owned power generating company)
PP	Pinjam Pakai (Lend Use)
PPD	Perusahaan Perseroan Daerah
PPSP	Percepatan Pembangunan Sanitasi Pemukiman (accelerated infrastructure project)
PT	Perseroan Terbatas (limited liability company)
PT PMA	PT penanaman modal asing (foreign investment company)
PT SMI	PT Sarana Multi Infrastruktur (Persero)
PT SO	PT Sumber Organic
PTUN	Pengadilan Tata Usaha Negara (state administrative court)
PU	Kementerian Pekerjaan Umum (Ministry of Public Works)
PUD	Perusahaan Umum Daerah
RKL/RPL	Rancangan Pengelolaan dan Pengawasan Lingkungan (environment monitoring plan)
RPJM	Rencana Pembangunan Jangka Menengah (mid-term development plan)
RW	Rukun Warga (community association)
SKPD	Satuan Kerja Perangkat Daerah (regional corporation or regional working units)
SP2LP	Surat Persetujuan Penetapan Lokasi Pembangunan
SPA	Stasiun Peralihan Antara (transfer station)
TPA	Tempat Pembuangan Akhir (final disposal site)
TPS	Tempat Penampungan Sementara (Temporary Solid Waste Collection Point)
TPS-3R	Tempat Pengolahan Sampah Dengan Prinsip 3R (Temporary Solid Waste Storage & Recycling Point)
TPST	Tempat Pengolahan Sampah Terpadu (Integrated Waste Processing/Treatment Facility)
UPS	Previous name for SPA (transfer station)
UPTD	Unit Pelaksana Teknis Dinas (Technical Implementing Units)